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PAPER TRADE JOURNAL

MARCH 7, 1946

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**PAPER TRADE JOURNAL**

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We join with our customers in welcoming the return of many of their employees from military and other national service to the positions they held in offices and plants.

We share the natural pride your employers take in your service to the nation and the hopes they have for your future.

Our representatives have already had the pleasure of personally greeting many of you who have served . . . they look forward to renewing their associations with all of you.

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**Soda Ash • Caustic Soda • Liquid Chlorine • Sodium Bicarbonate • Pittchlor (Calcium Hypochlorite) • Silene EF (Hydrated Calcium Silicate) • Calcium Chloride • Soda Briquettes • Caustic Ash • Phosflake • Calcene T (Precipitated Calcium Carbonate) • Modified Sodas.**

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Vol. 122, No. 10

PAPER TRADE JOURNAL

Title Reg. U. S. Pat. Off.

March 7, 1946

# Kimberly-Clark Co. Converts Defense Unit

## Kimlark Mill Which Produced Ordnance Parts Now Remodeled Into Staff Engineering Department—Winslow Leaves F. P. Laboratory Post—Tri-State Papermakers Meet—Other Industrial News.

APPLETON, Wis., March 4, 1946—The Kimlark mill of Kimberly-Clark Corporation, has been remodeled into the staff engineering department, the work having been done by the department itself, under the direction of William Cramer, chief designer.

The plant which housed the production of gun mounts and fuses during the war years is now engineering offices. The entire east half of the building has been completely remodeled to provide modern office facilities for 140 people.

Two available areas, one 40 by 75 feet, and one 85 by 128 feet have been finished as large open rooms with 11 foot ceilings. Floor surface, ceiling lights, ventilation outlets, heating and sprinkler system has been installed. The open rooms provide necessary changes in engineering department activity. Office partitions are only 7½ feet high so they may be set up, relocated or removed without affecting any of the room services. The partitions are made up in four foot panels and combinations of the panels form private offices, conference rooms and blueprint filing rooms.

Both of the main rooms are equipped with acoustical ceilings, panels of which are backed by an insulation product of the company which has acoustical properties.

### Valley Iron Works Receives Award

The Valley Iron Works Company, Appleton, Wis., manufacturer of paper mill machinery, received the 1945 award for chemical engineering achievement in connection with its work on the atomic bomb project Tuesday evening, February 26, at the Waldorf-Astoria in New York City. R. A. Peterson, company president, accepted the award in behalf of the company, which was also represented by W. K. Kolb, Harry Bennett and Paul Boronow.

### C. P. Winslow Leaves U. S. Laboratory

Carlile P. Winslow, 62, director of the United States Forest Products Laboratory, Madison, Wis., has resigned after 29 years in that capacity, the United States Department of Agriculture announced last week. George M. Hunt, also 62, has been appointed to succeed him.

Mr. Winslow will become a consultant in Forest Products to the United States Department of Agriculture's Forest Service in Washington. When he joined the Laboratory at its founding in 1910, there were a total of 80 employes. He became director in 1917. During the late war, the Laboratory, largest institution in the world devoted to research in the utilization of wood and related products, employed 700 persons. Mr. Hunt has been a member of the staff since 1913, and assistant Laboratory director since January, 1944.

### Tri-State Mill Men Meet

A Tri-State District Council meeting of the Papermakers, Pulp and Sulphite Workers and Converters of Minnesota, Upper Michigan and Wisconsin was held Sunday, March 3, at Wisconsin Rapids, Wis., with Badger Local 187 and the Pulp and Sulphite Locals 94, 102 and 105 as hosts. Consolidated Water Power and Paper Company joined the locals in extending a welcome to the more than 200 persons who attended the quarterly meeting.

A general meeting was held Sunday morning at the Elks Club and was followed by sectional meetings of papermakers, pulp and sulphite workers and converters. A general assembly was held at 1:30 in the afternoon to discuss problems of interest to all three groups.

Resolutions were considered by the council during the afternoon session for recommendation to the International Papermakers' convention at Columbus, Ohio, March 18-23. Alex Schoen, Green Bay, Wis., council president, presided at the general meetings, and K. W. Winter, Wausau, Wis., secretary, recorded the proceedings.

George A. Haberman, Milwaukee, Wis., president of the Wisconsin Federation of Labor, was the principal speaker at the 6:30 banquet. Stanton W. Mead, director of manufacture for Consolidated, was a guest speaker. William McCarthy, president of the Papermakers Badger Local 187 was the toastmaster. Consolidated sponsored an entertainer at the banquet.

### Employment is Round Table Subject

"Progress in Employment Practices" was the topic of a triangular discussion following a dinner meeting of the Marathon Round Table Wednesday evening, February 20, at the Twin City Y.W.C.A. About fifty members were present.

Taking part were R. E. Lauer, manager of the United States Employment Service office in Appleton, who acted as moderator; A. P. Engebretson, manager of the Neenah-Menasha USES; and Leslie Smith, personnel director of Thilmany Pulp and Paper Co.

# Chicago Concerned About Rising Costs

## Recent Revision of Writing Paper Prices Held To Stimulate Production But Provides Little To Aid Distributors Except Through Larger Volume — Salesmen honor New President — Other News.

[FROM OUR REGULAR CORRESPONDENT]

CHICAGO, Ill., March 4, 1946—Retailers of paper were interested in that part of the OPA's statement concerning revision of writing paper prices which read "this action permits manufacturers to charge a certain percentage more for the papers but makes no change in retail ceilings for the papers". Thus, the retail trade, while recognizing that the new ceilings on writing papers provides greater financial incentive to manufacturers to perform sheeting operations, it really isn't helping the distributive trade to live—though it may help through some increased volume later.

Current reports in this area indicate that expense rates in many manufacturing and jobbing operations are rising rapidly and that volume is nowise sufficient to cover the distinctly alarming situation. Thus, local paper trade observers are watching closely the hearings before the House Banking and Currency Committee and, in many instances, hoping that Congress will see fit to spell out a program to provide more actual incentive for production by properly covering increased costs of operations.

Marketwise, here, the waste paper trade continues to have difficulty in supplying mills, particularly with old newspapers. The situation is described as "critical" on several fronts.

### Salesmen Honor New President

Chicago sales executives are expressing genuine pleasure over the election of F. D. "Pat" Patterson as President of the Salesmens Association of the Paper Industry. Pat, assistant sales manager of the Flambeau Paper Company, is one of the most popular vice presidents the western division SAPEYES have had and everyone here is confident he will do an exceptionally fine job in the new spot. Pat came to Flambeau in 1927, fresh from Knox College, started at the bottom and, according to Jim Coy, has done an outstanding job. It is reported here that the annual sessions in New York attracted around 200 sales leaders who heard all of the various reports and elected the officers which include two popular western division leaders, Ed Edwards who becomes vice president, and Archie Hepburn, who takes Ed's old position as assistant vice president.

### For Sound Public Relations

Chicago's paper trade is developing another good speaker whose appearance is being sought by service clubs and other groups in this area. He is C. S. Peterson, advertising manager of the Chicago Paper Company, who talks on manufacturing and merchandising of paper. He has appeared before service club groups and, more recently, before employees of the H. P. Smith Paper Company of Chicago. Motion pictures developed by Hammermill are used to give illustrative punch to his discussions, according to reports.

### To Increase Newsprint Supply

An arrangement which will increase the North American supply of newsprint by 20,000 tons a year without reducing Canada's outprint of wallboard for housing, gets a great deal of publicity in the Chicago Tribune this week. The program resulted from an agreement between the Tribune's subsidiary, the Ontario Paper Company, and the adjacent Beaver Wood Fibre Company, Ltd. Under its terms the paper company will pipe steam to the wood fibre mill to operate a newsprint machine. Ontario will also supply the materials for paper production. The arrangement is reported to have been made possible now by recent price increases and is expected to add to the total supply of newsprint without reducing the production of wallboard. The two mills are located in such a manner that a common use can be made of existing facilities, according to the Chicago newspaper.

### Packaging Convention Meeting April 24

Publicity is already out for the annual convention and exhibits of the Industrial Packaging Engineers association which is to be held at the Hotel Sherman, April 24 to 26. About 5000 are expected to attend the meetings and visit the education exhibits, displays of labor saving devices and modern developments in the packaging field. It is understood that an exceptionally interesting speaking program is being arranged including discussions on cleaning, rust, preventatives, plastic coatings for precision and semi-precision products; interior packing and interior cartoning; boxing and crating and air cargoes. R. F. Weber, International Harvester Company, is president of the Association which has its headquarters at 134 S. LaSalle Street.

### Ditto Distributors in Illinois

Included among the Illinois firms selected as distributors for a new line of duplicating papers manufactured by Ditto, Inc., are the following: Chicago Paper Company; Parker, Schmidt & Tucker; Capital City Paper Company, Springfield and the J. W. Butler Paper Company in both Chicago and Peoria.

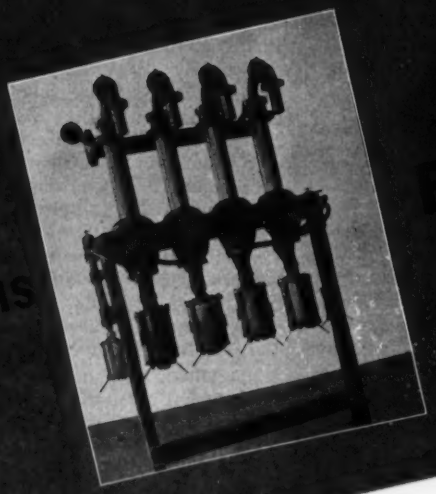
### W. M. Dixon Heads Red Cross Drive

Wesley M. Dixon, vice president of the Container Corporation of America, is to again serve as chairman of the Paper Group of the Business Division now engaged in raising $5,100,000 for the American Red Cross. Last year this division exceeded its quota by 11 per cent and is out to do as well or better on its $50,000 quota in the current campaign.

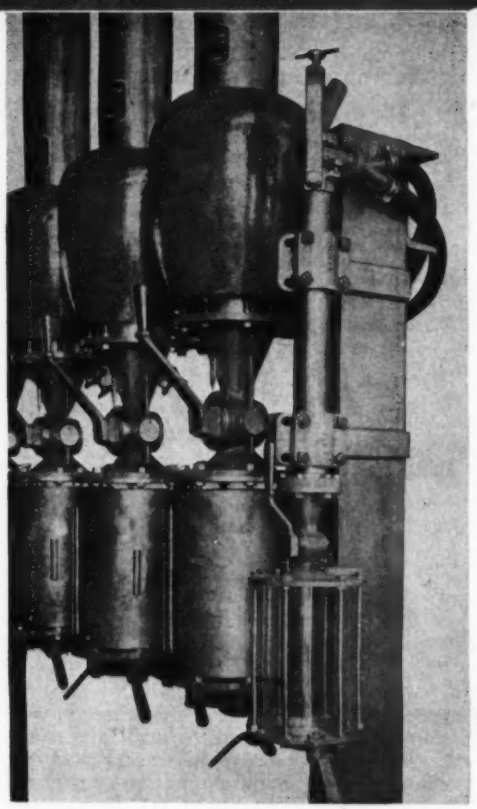
### New Dwight Vice President

John Ughetti, president of Dwight Brothers Paper Company of Chicago, has announced that C. Frederick Chapin, formerly of the Champion Paper and Fibre Company, is to beocme vice president and sales manager of the well known Chicago concern. Mr. Chapin was manager of the Cleveland sales office of Champion. He is an expert in the packaging field, particularly in relation to design and usage of paper. He came to Champion, in fact, to develop Champion Kromekote, now used for packaging, labeling and advertising.

RUN YOUR STOCK THROUGH THIS



BIRD DIRTEC AND WHAT HAPPENS . . .



Making use of the pressure-drop principle in a new and far more effective way, the Bird Dirtec yanks the dirt out of the stock and whisks it out of the system surely, smoothly and steadily. It's easy and inexpensive to install, operate and maintain. No moving parts.

Efficient, thorough, the Dirtec really does a job on paper dirt. Ask us to show you how it fits into your set-up and what it will do for you.

Close-up of the Bird Dirtec showing one of the auxiliary sections for removal of the finer and lighter dirt. This is direct connected and operates as an integral unit with the main dirt removal section.

**BIRD MACHINE COMPANY**

SOUTH WALPOLE, MASSACHUSETTS

World's Leading Manufacturers of Machinery for Making Paper Come Clean

## G. P. O. Bids Due March 18

WASHINGTON, D. C., March 5, 1946—The Joint Congressional Committee on Printing will receive bids on March 18 for paper for the use of the Government Printing Office for a 3-months period, beginning April 1. The Committee will meet March 25 to consider awards. They are asking for the following quantities of paper;

200,000 pounds catalog news.
1,300,000 pounds machine-finish book paper.
600,000 pounds English-finish book paper.
1,000,000 pounds offset book paper.
50,000 pounds antique book paper.
80,000 pounds 50% antique book paper.
1,000,000 pounds supercalendered book paper.
400,000 pounds machine-coated book paper.
150,000 pounds coated book paper.
80,000 pounds dull coated book.
1,950,000 pounds mimeograph paper.
200,000 pounds duplicator copy paper.
150,000 pounds U S M O safety writing paper.
9,680,000 pounds writing paper.
562,000 pounds map paper.
340,000 pounds manifold paper.
860,000 pounds bond paper.
2,000,000 pounds ledger paper.
400,000 pounds index paper.
130,000 pounds cover paper.
250,000 pounds manila paper.
200,000 pounds kraft paper.
50,000 pounds tag board.
90,000 pounds wood cardboard.
3,000,000 pounds postal card paper.
100,000 pounds news board.
50,000 pounds binder's board.
230,000 pounds chestnut coverboard.

In cases where more than 1,000 reams are called for, proposals will be received for 1,000 reams or more.

## Mead to Start Building at Macon

MACON, Ga., March 1, 1946—Herbert Kidd, who arrived here this week, has declared the Mead Paper Company will begin work on its $10,000,000 paper plant here within the next six weeks. Mr. Kidd was accompanied by construction officials.

"Construction workers will be the first of 1,500 persons to be employed by the new plant," Mr. Kidd said. "The new plant here will manufacture container board."

According to the Macon Telegraph, a number of company representatives have been busy for several weeks buying lands covered in pine timber and in making contracts for the purchase of timber in and around Macon.

## Start Building at Palatka

PALATKA, Fla., March 4, 1946—Construction has been started by the Hudson Pulp and Paper Corp. of New York City on a new $6,000,000 paper mill. The local plant, fireproof in construction, and covering approximately 150,000 square feet, will be equipped with a 234-inch paper-making machine, and the factory will have an initial capacity of 50,000 tons of kraft paper per year. When complete, it will employ 500 hands and woodsmen. The plant was designed by J. E. Sirrine & Co., of Greenville, S. C., and Merritt, Chapman & Scott Corp., contracting firm of New York City, has begun construction.

## Silverstein Heads Rogers Corporation

MANCHESTER, Conn., March 1, 1946—Advancement of three Rogers Corporation officials was announced recently, following a meeting of the board of directors of the local paper and plastics manufacturing concern.

Saul M. Silverstein, vice-president and general manager since 1938, was named president and general manager; Sidney A. Brown, production manager since 1938, was elected vice-president in charge of production; and Robert F. Hawley, assistant treasurer since 1927, was named treasurer and secretary. Raymond A. St. Laurent was reelected vice-president in charge of sales.

At the annual meeting held the same day, stockholders elected the following new directors: Philip C. Gifford, Gifford & Co., Providence, R. I., chairman; Henry J. Blais, president of the New England Bakery, Inc., Pawtucket, R. I.; Henry M. Herbener, management consultant, Thomasville, Ga.; Paul H. Hodge, Providence, R. I., attorney; and Ralph B. Rogers, president of Rogers Diesel & Aircraft Corporation, New York city. The following directors were reelected: Charles W. Greenough, budget director, commonwealth of Massachusetts; Newton P. Hutchison, Hutchison & Co., Providence, R. I., Hawley and Silverstein.

## Seaman Buys at Otter River

OTTER RIVER, Mass., February 25, 1946—The Seaman Paper Co., Chicago, has bought the mills of the New England Pulp and Paper Co. here and took over operation of the property from the Bay State Tissue Mills, Inc., on March 1. For the past several years this paper and pulp mill has been operated by the Bay State Tissue Mills, Inc., on towel, toilet, napkin, manifold and other grades of sulphite, groundwood and kraft. The pulp mill has produced groundwood and special pulps.

The paper mill is equipped with one 81-inch Moore and White Fourdrinier and has a rated capacity of 15 tons daily. The rated capacity of the pulp mill is 20 tons daily.

## United Paperboard Appoints Hedbring

Appointment of O. E. S. Hedbring as Assistant to the Vice President in Charge of Production, United Paperboard Company, has just been made known by P. M. Loddengaard, Vice President. Mr. Hedbring will make his headquarters at the company's Thomson Mill, in Thomson, N. Y. Formerly associated with the Ohio Boxboard Company in a similar capacity, Mr. Hedbring has also been connected with a number of pulp mills in the Pacific Northwest and with the Southern Kraft Division of the International Paper Company at Georgetown, S. C. Prior to joining the Ohio Boxboard Company he was assistant superintendent of the Continental Paper Company at Ridgefield Park, N. J.

## Dynes Joins CPA

WASHINGTON, D. C., March 6, 1946—Charles J. Dynes of Middletown, Ohio, has been appointed special assistant to the Administrator of the Civilian Production Administration and will give particular attention to problems involving pulpwood, pulp, paper and paperboard. Mr. Dynes was Deputy Director of the Paper Division under the old War Production Board.

## *AN IMPORTANT ANNOUNCEMENT*

**To Users and Converters of**
**Aluminum, Lead and Tin Foil**

As the recently appointed U. S. sales agents for Dominion Foils Ltd. of Canada, we can now make prompt deliveries of high grade aluminum, lead and tin foils.

These foils are produced by one of the finest and most up-to-date plants in the world, and their quality is equal to imported European grades.

Users and converters of aluminum, lead and tin foil are invited to send for quotations. Please specify type, caliper and approximate annual requirement.

## BULKLEY, DUNTON & CO.

**Specialty Division**

***295 MADISON AVENUE • NEW YORK 17, N. Y.***

## Salesmen's Assn. of Paper Industry

Forrest D. Patterson, Flambeau Paper Co. and formerly Western vice president of the Salesmen's Association of the Paper Industry, was elected to the presidency of the organization at its annual meeting held Monday afternoon at the Waldorf. He succeeds Stanley O. Styles, The Martin Cantine Co., who received from Mr. Patterson the past-president's medallion.

President Styles presented Thomas C. Hanna, Philadelphia representative of Missisquoi Corp., the President's Award for outstanding achievement in behalf of the association during the past year. Mr. Hanna formed the Philadelphia group and obtained 12 members on his own.

In addition to Mr. Patterson the following officers were elected: Western Vice-president, Edward J. Edwardes, Howard Paper Co.; assistant Western Vice-president, Archie Hepburn, Tomahawk Kraft Paper Co.; Eastern Vice-president, E. F. (Buddie) Miles, Crocker-McElwain Co.; assistant Eastern vice-president, Allan B. Helffrich, St. Regis Paper Co.; secretary-treasurer, Dr. E. O. Merchant.

In opening the well attended meeting, President Styles extended greetings and announced that following the business program there would be a cocktail party in charge of William Raymond and Mr. Helffrich.

## Glassine Group Elects Jennings

At the annual meeting of The Glassine and Greaseproof Manufacturers Association held at the Waldorf Astoria Hotel on February 28, the following officers

ELMER H. JENNINGS
Heads Glassine Group

were elected: Executive Committee; chairman, Elmer H. Jennings, vice president Thilmany Pulp & Paper Co.; Folke Becker, president, Rhinelander Paper Co.; Paul E. Hodgdon, president, Deerfield Glassine Co.; Paul F. Moore, president, Westfield River Paper Co.; John L. Riegel, president, Riegel Paper Corp.; and Arthur Schwab, managing director, Hamersley Mfg. Co.

## Coated and Processed Paper Assn.

The Coated and Processed Paper Association at its annual meeting on Monday at Hotel Commodore, re-elected James T. Cronk, Hampton Glazed Paper and Card Co., Holyoke, as president. Returned also to office was William B. Snow, Middlesex Products Corp., Cambridge, vice-president, manufacturing division. Attendance at the meeting and the luncheon which followed was, according to Executive Director Arthur Thomas, the largest to date. The group now comprises representatives of 25 manufacturers and 10 merchant firms. Others elected at the annual meeting were:

Vice-president, Merchandising Division, Charles Matthias Paper Corp., Philadelphia.

Arthur R. Walsh, Lachman-Novasel Paper Co., New York, as a merchandising member of the Executive Committee for the unexpired term ending in February, 1947, made vacant by the election of Charles Matthias as vice-president.

Leo R. McDevitt, Blackstone Glazed Paper Co., Pawtucket, R. I., as a manufacturing member of the Executive Committee for the term ending in February, 1949.

Charles H. Hoffman, of Hughes & Hoffman, New York, as a merchandising member of the Executive Committee for the term ending February, 1949. The other member of the Executive Committee is Sam R. Fry, of Wyomissing Glazed Paper Co., Reading Pa., as a manufacturing member whose term expires in February, 1947.

Arbitration Committee: Werner Kaufman, chairman, Kupfer Bros. & Co., New York; Robert C. Adams, The Marvellum Co., Holyoke; George J. E. Buell, Charles W. Williams & Co., New York; Samuel Lachman, Lachman-Novasel Paper Co., New York; John McLaurin, McLaurin-Jones Co., Brookfield.

Auditing Committee: Leo R. McDevitt, Blackstone Glazed Paper Co., Pawtucket, R. I.; J. Rudolph Metz, Metz Paper Co., Pawtucket, R. I. Treasurer: Arthur A. Thomas, who is also Executive Director.

## U. S. Pulp Producers Association

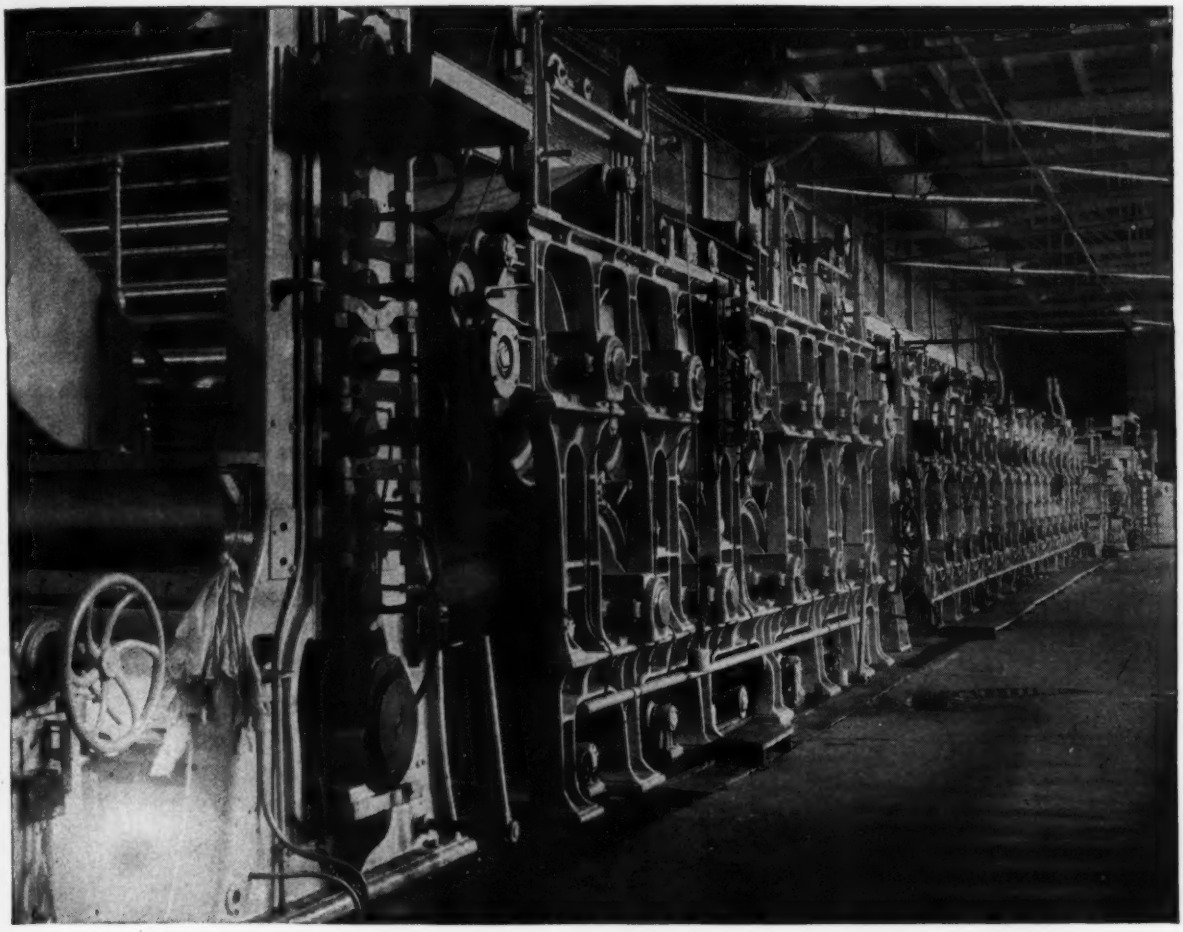
At the annual meeting of United States Pulp Producers Association, held at the Waldorf-Astoria on February 24, the following officers were elected:

Executive Board—1946

Regional Directors: New England — Amor Hollingsworth, Penobscot Chemical Fibre Company; Middle Atlantic — Norman W. Wilson, Hammermill Paper Company; South—James L. Madden, Hollingsworth & Whitney Company; Lake States—Stuart B. Copeland, The Northwest Paper Company; West Coast—Robert B. Wolf, Weyerhaeuser Timber Company.

Directors at Large: Downing P. Brown, Brown Company; Alexander Calder, Union Bag and Paper Corporation; J. M. Conway, Hoberg Paper Mills; U. M. Dickey, Soundview Pulp Company; R. K. Ferguson, St. Regis Paper Company; David Graham, West Virginia Pulp and Paper Company; Stuart E. Kay, International Paper Company; W. S. Lucey, Rayonier Inc.; Cola G. Parker, Kimberly-Clark Corporation; and Lawson Turcotte, Puget Sound Pulp and Timber Company.

Executive Director: Oliver M. Porter, 122 East 42nd street, New York 17.



# PROOF that you don't have to worry about CLUTCHES

Without exception, users of Fawick Airflex Clutches earn these advantages:

1 Torque, shock and vibration absorbed by air cushion.

2 No moving or wearing parts—no arms, springs or levers.

3 Direct or remote control by compressed air.

4 Uniform clutch engagement, controlled by a cushion of air.

5 No adjustments to make—no lubrication required.

6 Maintenance costs reduced — operation improved.

Ask our Engineering Department for recommendations to fit your machinery.

## FAWICK *Airflex* CLUTCH

FAWICK AIRFLEX CO., INC. • 9919 Clinton Road, Cleveland 11, Ohio

# Seen at the Chemical Show

### Allis-Chalmers Mfg. Co.

The exhibit of the Allis-Chalmers Manufacturing Company included a background of photographs of the concern's many types of heavy equipment for many types of industries. Also included were small sizes of centrifugal and self-priming pumps. An operating model demonstrated the company's varipitch sheaves. Centrifugal screens for heaviest duty, screens and sifters for light duty were featured.

Representatives present included: W. C. Johnson, vice president, R. S. Watson, E. J. Blackwell, D. E. Weller, William Arthur, V. A. Piehl, F. H. Kastin, R. K. Prince, and A. J. Cooper, manager of the New York office.

### Bemis Bro. Bag Co.

The exhibit of the Bemis Bro. Bag Company included a large display of the concern's bag lines. Included were multi-wall paper shipping sacks, Deltaseal paper bags and special paper bags. Also featured were the Bemis bag closing supplies, such as special thread, mainstay twine, rip-cord and heat sealing tape.

### Blaw-Knox Co.

At the Blaw-Knox Company Division of the Blaw-Knox Company, were featured large photographs showing the concern's extensive facilities for heavy metal fabricating, complete chemical plants and other processing equipment, such as stationary and tumbling digesters, including small digesters for experimental and laboratory use. A varied line of plug and stock valves was also exhibited.

Representative in attendance included H. L. Barnebey, R. H. Hazlett, G. M. Kirkpatrick, W. F. Simmons, H. Semmer, G. E. Kopetz, S. T. Russell, R. E. Moser and J. B. Alexander.

### Cambridge Instrument Co.

The exhibit of the Cambridge Instrument Company displayed the concern's varied line of recording and metering equipment, galvanometers, etc. Among the new instruments of precision on view were the concern's improved extension roll pyrometer, with new plastic case, which was equipped with a clear-vision dial, free from shadow, with Lucite cover, a new Ph recorder provided continuous indication with flow cell. Another new instrument was the $CO_2$ analyzer for flue gas.

### Crane Co.

Crane Company featured the concern's extensive line of fabrications. Also on exhibition were samples of the company's large line of valves and fittings for the chemical industry. Fabricated piping was also on display.

### Carnegie-Illinois Steel Corp.

The exhibit of the Carnegie-Illinois Steel Corporation and other subsidiaries of the United States Steel Corporation, exhibited specimens of tool and drill steels, and samples of various fabrications in stainless steels. Plate steel, hot rolled, pickled and in several finishes were also featured, as were stainless steel drums. A feature of the display was a large number of booklets of technical data and information of the company's extensive line of steel products.

Present were J. J. Ewing, F. Oelkers, C. J. Lundvall and H. R. Jones.

### General American Transportation Corp.

The exhibit of the General American Transportation Corporation featured molded plastics from many forms of plastic compounds. Among the phenolic plastic molded articles were wheels for industrial trucks and an electrical control panel.

### Grinnell Co.

The Grinnell Company exhibited piping and valves, including the Grinnell-Saunders diaphragm valves for corrosive fluids, air and water. Among the new items of equipment were a constant support hanger for pipe lines, taking care of thermal expansion. Another new item was the Grinnell Sway Brace, for preventing sway, with pre-compression, so force is immediately available to stop movements when they start. Also a new item was the Grinnell variable spring hanger to support piping where there are relatively small vertical movements due to thermal conditions.

Representatives present included H. Welshman, Jr., G. W. Day and A. B. Dondersley.

### Hercules Powder Co.

At the exhibit of the Hercules Powder Company were displayed chemical materials for industry, including those available for the paper and pulp industry, such as rosin size, Parocal wax coating, casein and pine oil.

Representatives present included E. H. Cone, T. L. Stirling, Henry Reeves, Don Martin, R. T. Washburn, G. J. Rising, M. L. Little and M. M. Bixby.

### Swenson Evaporator Co.

The Swenson Evaporator Company, Division of Whiting Corporation, displayed large photographs of its processing equipment, which included evaporators, filters, crystallizers, causticizing equipment, traveling cranes, pulverizers, and special chemical machinery. Featured was the Swenson-Nyman multi-stage pulp washers of high efficiency because of the unique design which provides more than 40% of the total drum surface in the washing area. The concern's digester heat recovery system which keeps tubes clean, was also featured.

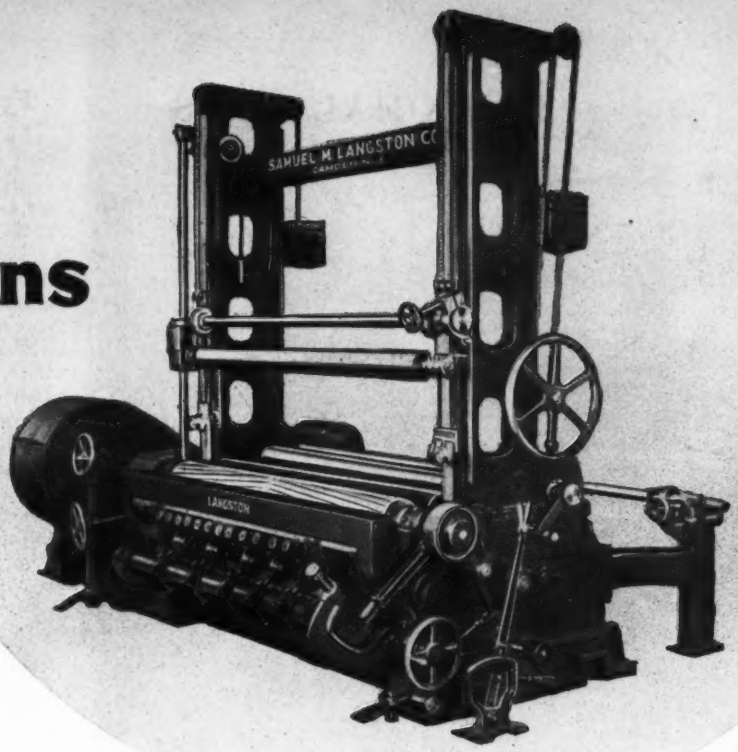
Representatives present included G. E. Seavoy, vice president, J. E. Kearney, H. B. Caldwell, manager of the New York office, W. D. Kohlins, Art Francis, J. R. Lientz, R. A. Garnett, A. Ritchie and J. W. Wilcox.

### Bird Machine Co.

The featured equipment of the Bird Machine Company of particular interest to the pulp and paper industry was the Bird-Young filter for pulp and coating clays. For the chemical industry the company exhibited centrifugal filters of screen types.

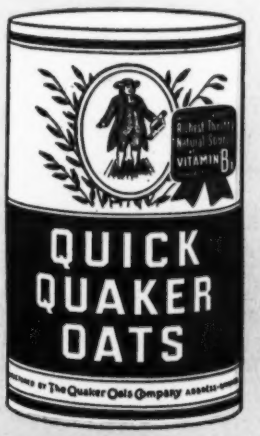
Representatives present were George Sherrerd, Jr., F. R. Becker, F. X. Ferney, E. G. Piper, H. H. Shephard, E. Beach and J. Gillis.

# Successful Combinations



**On the breakfast tables of America, "oatmeal-and-cream" has always been a popular team. The familiar Quaker Oats package that brings you this wholesome food is made with the help of a Langston "BA" Slitter and Roll Winder. Noted for the excellence of their products, The Quaker Oats Company, Chicago, find that Langston Slitters fully meet their exacting standards in the production of the package.**

**Wherever paper is processed; in the Mill, the Finishing Room, or the Converting Plant—Langston Slitters and Roll Winders assure dependable, trouble-free service.**




**SAMUEL M. LANGSTON COMPANY**
**CAMDEN, N. J.**

# Langston

**SLITTERS AND ROLL WINDERS**

# FINANCIAL NEWS

## New York Stock Exchange

High, Low and Last for Week Ending March 2, 1946

STOCKS

| | High | Low | Last |
|---|---|---|---|
| A. P. W. | 9 | 8⅜ | 9 |
| Armstrong Cork Co. | 55¼ | 51½ | 53¾ |
| Celotex Corp. | 27⅛ | 24⅜ | 25⅜ |
| Celotex Corp., pf. | 21⅜ | 20¾ | 20¾ |
| Certain-Teed Products Corp. | 18½ | 16⅞ | 17⅞ |
| Certain-Teed Products Corp., pf. | 110 | 109 | 110 |
| Champion Paper & Fibre Co. | 48¼ | 45 | 45 |
| Champion Paper & Fibre Co., pf. | 110¾ | 108½ | 110¾ |
| Congoleum Nairn Co. | 34½ | 32¼ | 33¼ |
| Container Corp. of America | 42¾ | 38¼ | 39½ |
| Continental-Diamond Fibre Co. | 16½ | 15½ | 15⅝ |
| Crown-Zellerbach Co. | 32⅜ | 30⅛ | 31¼ |
| Crown-Zellerbach Co., pf. | 109 | 108 | 109 |
| Dixie Cup Co. | 41 | 39 | 41 |
| Dixie Cup Co.—A | 54 | 52¾ | 53½ |
| Flintkote Co. | 38¾ | 34¼ | 35⅝ |
| Flintkote Co., pf. | 112 | 111½ | 111½ |
| Robert Gair | 9¾ | 8½ | 9⅜ |
| Robert Gair, pf. | 20¼ | 20 | 20¼ |
| International Paper Co. | 43½ | 40⅜ | 40⅞ |
| International Paper Co., pf. | 113¾ | 111⅝ | 111⅝ |
| Johns-Manville Corp. | 143 | 138 | 140½ |
| Johns-Manville Corp., pf. | ... | ... | ... |
| Kimberly-Clark Corp. | 62½ | 60½ | 61 |
| Mac Andrews & Forbes | 37 | 36 | 36½ |
| Mac Andrews & Forbes, pf. | ... | ... | ... |
| Masonite Corp. | 58¾ | 52½ | 55½ |
| Mead Corp. | 21¾ | 19⅞ | 20¾ |
| Mead Corp., pf. A—6% | 107½ | 107 | 107½ |
| Mead Corp., pf. B—5½% | 105½ | 104¾ | 105 |
| National Container Corp. | 26½ | 24 | 24½ |
| Paraffine Companies, Inc. | 80 | 75½ | 76½ |
| Paraffine Companies, Inc., pf. | ... | ... | ... |
| Rayonier, Inc. | 24⅝ | 22½ | 23⅞ |
| Rayonier, Inc., pf. | 38⅛ | 37⅜ | 37⅝ |
| Ruberoid Co. | 45¾ | 44 | 44½ |
| Scott Paper Co. | 55⅝ | 53½ | 53½ |
| Scott Paper Co., pf. | 109 | 109 | 109 |
| Sutherland Paper Co. | 41 | 38½ | 40½ |
| Union Bag & Paper Corp. | 24⅞ | 23⅛ | 24¼ |
| United Paperboard Co. | 11 | 10 | 10⅜ |
| U. S. Gypsum Co. | 115 | 108 | 114 |
| U. S. Gypsum Co., pf. | ... | ... | ... |
| West Virginia Pulp & Paper Co. | 40½ | 35¾ | 38 |
| West Virginia Pulp & Paper Co., pf. | 115 | 114 | 115 |

BONDS

| | | | |
|---|---|---|---|
| Abitibi Pulp & Paper Co. 5s '53 | 108 | 107 | 107¾ |
| Celotex Corp. 3¾s '55 | ... | ... | ... |
| Certain-Teed Products Corp. 5½s '53 | ... | ... | ... |
| Champion Paper & Fibre Co. 3s '65 | 105⅛ | 105⅛ | 105⅛ |
| International Paper Co. 5s '47 | 103¾ | 103¼ | 103¼ |
| Mead Corp. 3½s '53 | ... | ... | ... |

## New York Curb Exchange

High, Low and Last for Week Ending March 2, 1946

STOCKS

| | High | Low | Last |
|---|---|---|---|
| Great Northern Paper Co. | 42 | 39½ | 40 |
| Hummel-Ross Fibre Corp. | 12½ | 11⅝ | 11¾ |
| St. Regis Paper Co. | 10⅝ | 9¼ | 9⅞ |
| St. Regis Paper Co., pf. | ... | ... | ... |
| Taggart Corp. | 9⅞ | 9 | 9⅛ |

BONDS

| | | | |
|---|---|---|---|
| American Writing Paper Co. 6s '61 | 101½ | 101⅛ | 101½ |

## Maclaren Co. Issues Report

MONTREAL, Que., March 4, 1946—The report of the Maclaren Power and Paper Company for the year ended November 30, 1945, shows that net profit for the year, before tax provision, amounted to $1,904,870, as compared with $1,903,143 in the previous year. Taxes absorbed $905,000, against $1,059,500, resulting in consolidated net profit, transferred to surplus account, of $999,870, compared with $843,643 at the previous year end.

Above net is equal to $2 per share on 500,000 shares outstanding compared with $1.68.

Consolidated net working capital expanded to $7,161,301.

The paper subsidiary, The James Maclaren Company, Limited, shows sales of $4,133,188 compared with $3,938,115 in the previous year. Profit before income tax was $1,444,708 against $1,203,816. Tax provision was $665,000 against $751,500 and net profit $779,707 against $452,315.

The other subsidiary, Maclaren-Quebec Power Company, shows a decrease in power sales. The sales totalled $2,287,726 against $2,532,343.

## Frasier Co.'s Earnings at Record High

MONTREAL, Que., March 4, 1946—The annual report of Fraser Companies Limited, of Edmundston, N. B., for the year ended December 31, 1945, shows net earnings at an all-time record of $1,763,638, equal to $4.75 per share of stock.

The 1945 net compares with $1,457,751 or $3.93 per share reported for 1944, in which year, in addition, there was earned $259,000 or 70c per share by way of refundable portion of excess profits taxes. There was no refundable portion of taxes earned in 1945. Dividends were continued during 1945 and four 50c quarterly dividends totalling $2.00 were charged to the year's statement. In 1944, three 35 cent quarterly dividends totalling $1.05 were paid.

Total pulp and paper tonnage was approximately the same as in the previous year. The diversion of woodpulp from the company's Madawaska paper mills to other consumers by direction of the United States War Production Board was not in effect during the last quarter of the year.

## Container Corp. Earns $2.59

The Container Corporation of America reports a consolidated net profit for 1945 amounted to $2,026,103 compared to $2,063,199 for 1944, equivalent to $2.59 and $2.64 per share respectively on each of the 781,253 outstanding shares of capital stock.

Consolidated net sales for the year amounted to $74,138,191, an increase of 6.5% over the previous year and a new peak in the Company's history. The tons shipped increased 2.1%. A greater proportion of higher quality mill product was produced and more tons were shipped in a final fabricated form than in the previous year, which accounts for the greater increase in dollar sales than in unit volume.

The lower profit margin, in spite of substantially higher sales, was a result of a gradual though inexorable creeping up of costs against rigid and unmoving O.P.A. ceilings in many divisions of the Company's business.

## Bowater's Net Profits Up

MONTREAL, Que., March 4, 1946—The annual report of Bowater's Newfoundland Pulp and Paper Mills for the year ended December 31, 1945, shows net income for period of $2,409,020 as compared with $2,568,946 in 1944 period and after lower depreciation and bond and debenture interests, net profit is shown at $1,028,132 as compared with $711,509 in 1944.

Net profits increased by 44% and earnings per share were equal to 34 cents a share as against 24 cents a share year previous. After dividends, surplus for year was shown at $692,882 vs. $41,009.

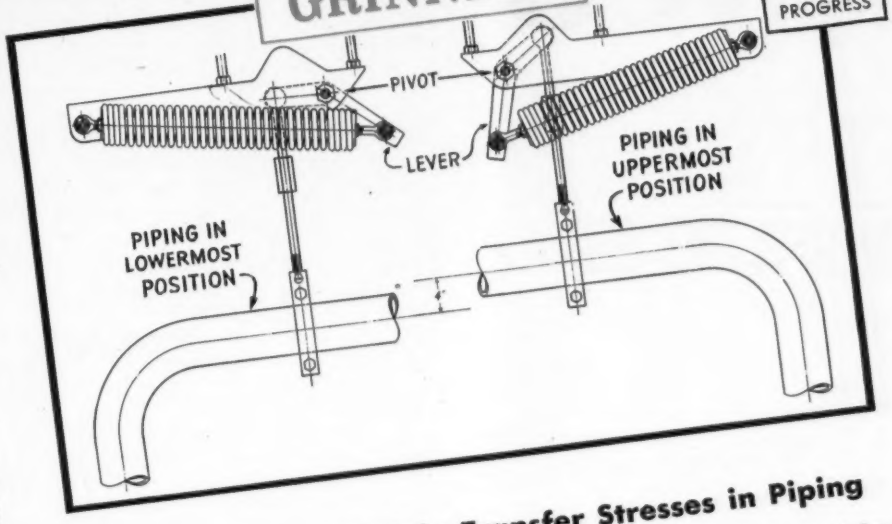
Total current assets improved to $12,040,189 from $10,754,617 and total current liabilities were also higher at $2,710,622 from $2,116,642.

## Gair Declares Dividend

At a meeting of the Board of Directors of Robert Gair Company, Inc., held on February 27, 1946, a quarterly dividend of thirty cents per share in respect of the first quarter of the year 1946 was declared on the preferred stock of the par value of $20 per share of the Company, payable April 1, 1946 to stockholders of record at the close of business on March 7, 1946 without the closing of the transfer books.

GRINNELL

PIPING PROGRESS




## Elimination of Weight Transfer Stresses in Piping

*Question:* **How can weight transfer stresses be eliminated from piping subject to vertical movement, thereby maintaining the full safety factor of the system?**

*Answer:* **By the use of hangers which provide constant support to the piping throughout the entire range of vertical movement.**

The above diagram of a Grinnell Constant-Support Hanger in operation illustrates how constant support is provided. A lever, turning on the main pivot, balances the weight of a vertically shifting load because the change in moment arm with lever rotation is such that the product of the moment arm and the spring force is always constant and equal to the weight of the piping system.

WHENEVER PIPING IS INVOLVED

The designing and production of pipe hangers to meet the varied requirements caused by expansion, contraction, pressure, vibration and load call for a thorough working knowledge of springs, levers and other mechanical devices as well as of pipe and piping systems. As a result of 95 years of piping experience and continuous laboratory research and experimentation, Grinnell is able to offer standard and special-purpose hangers to meet every conceivable requirement in piping.

Whenever piping is involved – Grinnell has the specialized engineering knowledge to handle the job – from first plan to actual operation. Grinnell can supply everything from a tiny tube fitting to a complete power plant installation.

GRINNELL COMPANY, INC. Executive Offices, Providence 1, R. I. Branch warehouses in principal cities. Manufacturing Plants: Providence, R. I.; Cranston, R. I.; Atlanta, Ga.; Warren, Ohio; Columbia, Pa.

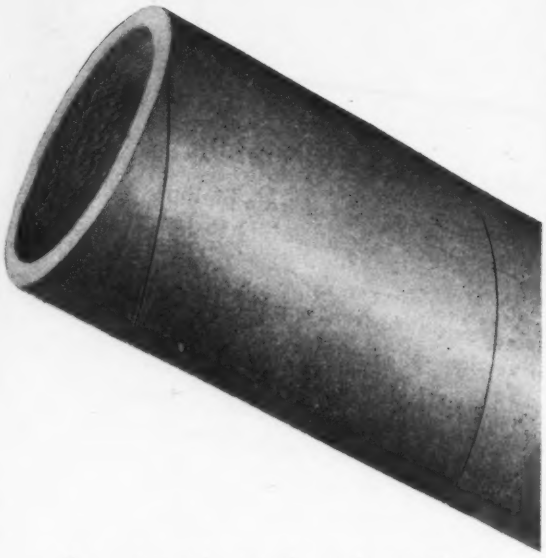
GRINNELL

WHENEVER PIPING IS INVOLVED

SONOCO

RHINO
NON-RETURNABLE

CORES



An extremely tough and practical core of tested strength for one-time use, and priced accordingly. We have been able to maintain prewar quality standards and adequate production on this core with which to serve a wide range of uses where practical to use this type.

RETURNABLE CORES

**Grade A**—Heavy Duty Metal Ends—Fibre Stock Construction—strong, rugged, hard finish.

**Grade B**—"All Purpose Metal" Ends—Heavy Laminated Paper Construction.

SONOCO MAKES *EVERYTHING* IN *PAPER CARRIERS*

SONOCO PRODUCTS COMPANY

BRANTFORD ONT. HARTSVILLE S. C. MYSTIC CONN.

SHIPPING POINTS: LOWELL, MASS. HARTSVILLE, S. C.

DEPENDABLE SOURCE OF SUPPLY

## Puget Sound Issues Report

Preliminary figures, subject to audit, indicate that Puget Sound Pulp and Timber Company realized a net income of $602,624 in 1945, composed of $409,530 net profit from operations after providing $450,000 for Federal taxes, and $193,094 net capital gain from an installment payment received on the sale of Canadian timber properties.

Net profit from operations in 1944 amounted to $429,220, after $475,000 for Federal taxes, and an instalment payment on the Canadian timber sale produced $509,067 net capital gain, making $938,287 net income for that year.

Operating net, after payment of preferred dividends, equaled $1.05 a share for the common stock in 1945, in comparison with $1.11 in 1944. The net capital gain realized in 1945 was equal to 59 cents per common share, which, added to $1.56 a share in 1944, makes $2.15 a share thus far realized from timber payments received.

Pulp mill operations were conducted 278 days in 1945, against 302 days in 1944. Pulp production totaled 87,641 tons in 1945, compared with 98,986 tons in 1944. Net sales and other income totaled $6,327,831 in 1945, in comparison with $6,575,474 the previous year. After a non-recurring charge of $38,079 covering flood losses sustained in October, profit before Federal tax provisions amounted to $859,530, which compares with $904,220 in 1944.

In the fourth quarter of 1945, 20,337 tons of pulp were produced during 67 days of mill operations, against 23,292 tons of production in 75 operating days in the final quarter of 1944. Net sales and other income amounted to $1,362,113 in the fourth quarter of 1945, and to $1,509,146 in the comparable period of 1944.

Operation of the new alcohol plant during the last ten months of the year resulted in production of 1,292,937 gallons of 190 proof industrial alcohol from waste sulphite liquor.

## Donnacona Co. Earns 77 Cents

MONTREAL, Que., March 4, 1946—The report of the Donnacona Paper Company Limited for 1945 shows that operating profit, after all charges, was equal to 77 cents a share, as compared with 73 cents a share in 1944. Total operating profit was $1,354,378, an increase of about $40,000 over 1944 figure of $1,314,688. Depreciation write-off was unchanged at $548,169 and income and e.p. taxes were up at $249,714, from $200,000. Fixed charges, however, were lower at $267,334 as compared with $292,757 in 1944. After all charges and appropriations, net earnings for last year are shown at $289,161, as compared with $273,725 for previous year. After payment of dividends, same as in 1944 at $188,286, accumulated surplus shows an increase to $1,298,649 from $1,197,773 at end of year before.

## Bergstrom Increases Capital Stock

APPLETON, Wis., March 4, 1946—The Bergstrom Paper Company, Neenah, Wis., has increased its capital stock $400,000, from $1,500,000 to $1,900,000, according to an amendment to the articles of incorporation filed recently with the Winnebago county clerk at Oshkosh, Wis. There are 15,000 shares of common stock and 4,000 shares of preferred, each having a par value of $100.

# LASTING CORROSION RESISTANCE for Kraft FOURDRINIER WET ENDS!

*Wet end of* PUSEY & JONES *234-inch news Fourdrinier built for Southland Paper Mills, Lufkin, Texas. Slice lips, wire rolls and other parts are Monel...for lasting resistance to wear and corrosion.*

Mixed Southern groundwood and bleached Kraft stock have little corrosive effect on the Monel parts of this 234-inch **Pusey & Jones** news Fourdrinier.

Proof is found in tests conducted under actual operating conditions.

*Stock and white water going over this machine would require 120 years to destroy a 1/16-inch sheet of MONEL by corrosion from one side!*

This remarkable resistance to corrosion . . . plus high strength and the ability to withstand wear . . . accounts for the use of Monel in the **Pusey & Jones** wet end pictured above. And it is these qualities, too, which fit Monel especially for the uses listed at the right.

Wherever corrosion causes trouble, mills and machine builders depend on Monel. They rely also on INCO's Technical Staff which is always ready to assist or advise them in selection of the right metal or alloy for a specific job.

When *you* need help on metal and corrosion problems, write to INCO at the address below. At the same time, ask for Bulletin C-3, *Monel, Nickel and Inconel in Pulp and Paper Mills.* It contains valuable information with which you'll want to be familiar before you specify new equipment or make changes in your present machines.

**THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK 5, N.Y.**

**MONEL**

**NICKEL** INCO TRADE MARK **ALLOYS**

MONEL*- "K" MONEL*- "S" MONEL*- "R" MONEL*- "KR" MONEL*- INCONEL*- NICKEL - "L" NICKEL*- "Z" NICKEL*

*Reg. U.S. Pat. Off.

## PRINCIPAL USES OF MONEL ON FOURDRINIER WET ENDS*

*Apron Plates*—Monel Strip.

*Bolts & Other Fastenings.*

*Beams and Rails*—Monel Sheet lining over steel or cast iron.

*Brace Rods*—Cold-drawn Monel rods.

*Breast Rolls*—Monel covered construction.

*Dandy Rolls*—Monel body and face.

*Distributor Rolls*—Perforated Monel tube rolls.

*Doctor Blades & Backs*—Full hard Monel blades. Sheet and angles for doctor back.

*Flow Boxes*—Monel linings or self-supporting sheet construction, or built from Nickel-Clad Steel.

*Rectifier Plates*—Monel sheet.

*Remover Beam Rollers*—Gall resisting cast "S" Monel.

*Remover Cross Drive Shafts*—Cold-drawn Monel rods.

*Save-All Trays and Pans*—Welded Monel sheet construction.

*Shaker Springs*—"Z" Nickel for leaves with high stroke frequencies.

*Shower Pipes & Nozzles*—Monel tubing and "R" Monel rod (200BHN) for nozzles.

*Slice Blades*—Special Tempered cold-rolled Monel strip. Slice lips up to 250" long are supplied.

*Suction Boxes*—Tubing up to 5" O. D. Monel-covered steel tubes for larger diameters.

*Wire Return Rolls*—1/8" Monel covers over steel tubes.

**Under exposure to corrosive conditions generally met, Monel* is safely used in combination with bronze and copper.

## E-M Features Magnet

A new 16-page booklet, No. 183, published by Electric Machinery Mfg. Company, Minneapolis 13, Minn., presents factual data and over 40 illustrations covering the E-M Magnetic Adjustable-Speed Drive for boiler draft fans, centrifugal pumps, centrifugal blowers and compressors, and other loads where torque required decreases with reduction of speed. Principles of operation, performance characteristics, and applications are described and illustrated.

The E-M Magnetic Adjustable-Speed Drive is an electro-magnetic torque transmitter, placed between a constant speed motor and the equipment to be driven, to provide easily-adjustable, micro-step, wide-range control of speed.

## Cordes Moves Up

In the re-alignment of the Downingtown Manufacturing Company sales department, necessitated by the death of the late Jay Edge, Oscar Cordes has been made assistant sales manager. Oscar's activities with Downingtown during the last eleven years are excellent preparation for the discharge of his widened duties.

OSCAR C. CORDES
Downingtown Promotes Him

Before joining the Downingtown organization, Oscar spent some fourteen years in the general engineering department of the Westinghouse Corporation working on paper mill applications. During this period he patented a number of devices applying electrical controls to paper making equipment.

March 7, 1946

AN OPEN LETTER TO
PAPER MILL SUPERINTENDENTS

Gentlemen: Re: DE-INKING

A small amount of "K-140" added to properly balanced alkalies used in De-inking will increase Cleanliness and Brightness of the stock. "K-140" is of particular importance when de-inking today's low grade papers containing asphalt ink and ground wood.

A letter to Kinsley's Technical Department indicating the system and equipment now in use in your mill will assist us in setting up the formula best suited to your individual problem.

Yours truly,

THE KINSLEY CHEMICAL COMPANY
12500 Berea Road
Cleveland 11, Ohio.

P.S. If you are cooking Rags, "K-121-B" will improve your results.

## Wholesale Trade Up

WASHINGTON, D. C., March 1, 1946 — Wholesalers' sales of paper and paper products totaled $86,877,000 for the calendar year 1945, a gain of 2 percent over 1944, according to the Bureau of Census, based on reports from a representative group of firms. Sales by this group for December, 1945, totaled $4,436,000, a decline of 13 percent from November, but 2 percent above those of December, 1944. Inventories shown by a reporting group for December, 1945, were 2 percent under those of November, but 4 percent higher than for December, 1944.

## Lewis Advances

James P. Lewis, son of H. S. Lewis, president of the J. P. Lewis Company, and grandson of James P. Lewis, the founder of the company, has been elected vice-president, assistant treasurer, and a director. Mr. Lewis was graduated from Overfield Academy and Williams College. He served two and one-half years with the U. S. Coast Guard and the Army Transport Service, and returned to his former duties in October of last year.

# MORE AND MORE SPECIFIED for making high freeness insulating board pulp . . .

## The NORTON Open Structure PULPSTONE

This newest Norton Pulpstone combines the features of OPEN STRUCTURE (large pore space) with the advantages of 38 ALUNDUM abrasive. The result is a stone for board pulp mills that is cooler running and that produces pulp of a higher strength to freeness ratio than that obtained by any previous type of stone.

Improved, too, is the internal construction of this stone. Its design was developed especially to meet the requirements of today's mills with their high power input, high temperature grinders.

Specify this Norton Pulpstone for operation in insulating board mills.

**NORTON COMPANY**
**WORCESTER 6, MASSACHUSETTS**

Norton Company of Canada, Ltd.
Hamilton, Ont.

NORTON ABRASIVES

PAPER
TRADE JOURNAL
Reg. U. S. Pat. Off.
W. L. Cook, Editor

## PUBLIC RELATIONS

Every interest in the pulp and paper industries has a direct stake in the proposal of the American Paper and Pulp Association to set up a broad public relations program that shall act for the industry's welfare. This recognizes that there are many groups within the industry whose own problems and policies suggest a highly specialized and restricted participation in such a program. According to the markets in which his product is sold, and the uses for which it is designed, it is quite possible that the paper maker may feel that, so far as public relations is concerned he has to shoulder his whole load for himself, and he is quite willing that others should do likewise. Willing to bear his own burden, he has believed that others could not properly be called upon to help him: bearing his own burden, he has worked at it with such concentrated zeal that he has failed often to see that in his own successes he might be helping others too.

A long tradition lies back of such viewpoint to be sure. Paper, for generations, has been used to write on or to wrap things in, and that was all there could be said about it. People wanted to buy the stuff; ergo there was a profit to be derived from making it. In the course of a few decades policies of honest dealing, of intelligent application to improvements in the product, of skillful buying and economical selling established trade connections that spelled reputation and profits for some prominent names. Policies of specializing, of advertising, of service to the market grew out of this and public recognition of some paper names attests sufficiently to the success of such healthy exploitation of a history of earnest effort to please the public.

But while this industry, or this group of industries —as you will—remains largely a grouping of highly individualized units it must be recognized by the more thoughtful that all these units have more than one thing in common. That is the very thing which binds them with an industrial entity. Appreciation of this community of interest may be expected to grow as the next few years develop their record, and with that appreciation those who have studied the problems of pulp and paper look forward to a more eager willingness to attack jointly such problems as may arise.

First there is the matter of public understanding. Possibly of recent years there has been no more successful public educational program than that of the railroads. Frankly dressed as an appeal to the public in the interest of common problems of the rail carriers its whole aim has been to build and hold a good will that will be needed when reduction in the volume of travel shall make the competition of bus and plane more keenly felt. The campaign has passed beyond the experimental stage and has reached the stage of giving point to a jest in which there is enough sober truth to win for the roads a deep respect for their frankness. "Who says the railroads have done a swell job?" And the answer: "The railroads say it." Who, after all, has a better right to talk about an industry than the industry itself?

From the vantage of public point of public understanding it is only a step to the assurance of public good will, and this is an intangible commodity of which we can never have more than enough. Out of good will grows confidence and a long train of other desirable attitudes, including even support where and when that may be required. Industrial history, including that of the paper industry, is replete with illustrations of the benefit to which this good will can be turned by companies which have cultivated it wisely and honestly and soundly. Even acute problems have been solved at times by industrial cooperation, though often the process has been costly when it was initiated after need had been forcefully called to attention. Actually the need always is present.

Though the immediate attack and the goals of such a campaign by the pulp and paper industry have as yet to be formulated in final form, the benefits of such action as that which has been proposed for this industry are many and valuable. The true public relations program aims at something more than simply putting pieces in the paper, necessary as is the good will and cooperation of the public press. The public is something more than the man who buys paper. He is the taxpayer, for instance. He is the employe. He is the source of supply for materials and equipment. He is always the man whom it is profitable to cultivate for his good will. He is the man who, if he does not know your story, does not know how necessary you are to his daily welfare, never hears about your plans to be more useful to him, is quite as apt to think of you some day, as another head to be clubbed, another corporation to be hit in the treasury. You cannot buy his good will on any permanent basis, but you can sell him yourself.

Only a first step has been taken, to be sure, in developing a rounded good will program for the industry. But that it has been taken is significant, and constitutes a bid for whole-hearted support in the evolution of the policies that have been entrusted to a group of skilled paper men for reduction to working forms. The result of their labors, it may be expected, should be an outline to which the whole industry will subscribe, from the cooperative interest that everyone has in the success of his competitors.

### CALENDAR OF COMING EVENTS

**March 20, 1946—National Association of Waste Material Dealers, Victory Banquet, Hotel Astor, New York.**

**April 1-3, 1946.—National Paper Trade Association, Annual Convention, Waldorf Astoria Hotel, New York.**

**June 17-20, 1946.—American Pulp and Paper Mill Superintendents Association, Annual Convention, Poland Spring, Me.**

## Electric Strike Affects Mills

HOLYOKE, Mass., February 16—The strike of 200,000 CIO electrical workers throughout the country has made itself felt indirectly in the papermaking industry here with the Stevens Paper Mills, operating one mill in South Hadley Falls and two others in Westfield, already affected. As a result the Stevens Mills have reduced from the seven-day working week, under which it had ben operating for about four months, to six.

The Stevens Mills manufacture exclusively in their three mills condenser tissue, which is used by General Electric, General Motors and similar organizations in electrical instruments.

## South Seeks $5 Pulpwood

COLUMBIA, S. C., February 28, 1946—The agriculture committee of the South Carolina Senate yesterday advocated a $5-a-cord minimum price for pulpwood sold by growers.

The committee so amended a House concurrent resolution asking Congress, the Office of Price Administration and other agencies to increase present pulpwood price ceilings for the Southern growers.

## Canada Has New Forestry Plan

MONTREAL, Que., March 4, 1946—A new plan for a national "parliament" on forest conservation, with each Canadian province contributing five representatives, is announced by the Canadian Forestry Association.

This "parliament" will in future govern the policy of the national board of the association. The provincial nominees will be supplemented by the selection of a number of directors-at-large who have special qualifications in the field of forest management.

This year the "cause of conservation" will be served by seven branches of the association.

## Production Ratio Report*

(Production as per cent of six-day capacity)

COMPARATIVE WEEKLY SUMMARIES

| Current Weeks—1946 | | Corresponding Weeks—1945 | |
|---|---|---|---|
| Jan. 19 | 94.4 | Jan. 20 | 89.0 |
| Jan. 26 | 94.5 | Jan. 27 | 88.4 |
| Feb. 2 | 101.5 | Feb. 3 | 88.8 |
| Feb. 9 | 99.7 | Feb. 10 | 90.1 |
| Feb. 16 | 95.0 | Feb. 17 | 91.0 |
| Feb. 23 | *98.0* | Feb. 24 | 89.7 |

COMPARATIVE MONTHLY SUMMARIES

| Year | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Year Avg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1945 | 86.7 | 89.4 | 90.2 | 88.1 | 89.8 | 91.2 | 80.8 | 88.6 | 90.2 | 95.9 | 95.5 | 91.0 | 89.7 |
| 1946 | *94.7* | | | | | | | | | | | | |

COMPARATIVE YEARLY SUMMARIES

| | 1939 | 1940 | 1941 | 1942 | 1943 | 1944 | 1945 | 1946 |
|---|---|---|---|---|---|---|---|---|
| Year to Date | 78.1 | 87.8 | 87.4 | 104.2 | 88.0 | 88.6 | 87.0 | *95.6* |
| Year Average | 83.4 | 85.6 | 97.4 | 90.4 | 87.8 | 88.1 | 89.7 | |

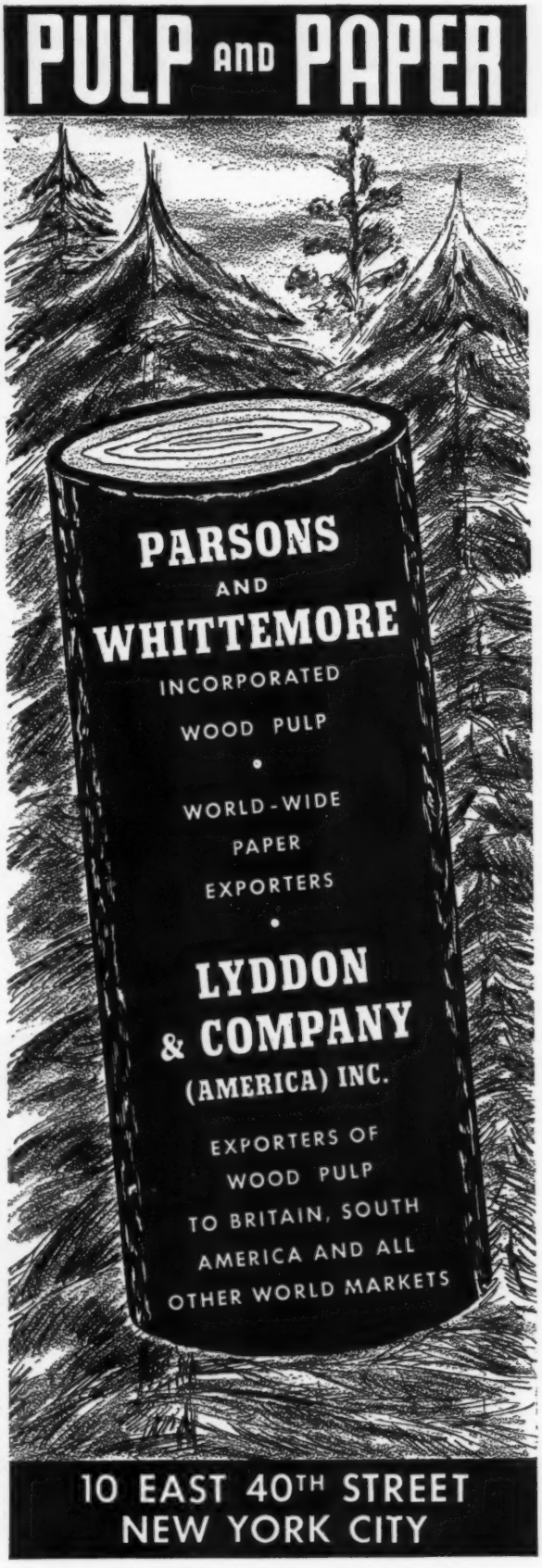
* Based on tonnage reported to American Paper and Pulp Association. Does not include mills reporting to National Paperboard Association, except in isolated cases where both paper and paperboard are produced and separate tonnage figures are not readily available. Does not include mills producing newsprint exclusively.

PAPERBOARD OPERATING RATIOS †

| Current Weeks—1946 | | Corresponding Weeks—1945 | |
|---|---|---|---|
| Jan. 19 | 93 | Jan. 20 | 94 |
| Jan. 26 | 94 | Jan. 27 | 95 |
| Feb. 2 | 95 | Feb. 3 | 92 |
| Feb. 9 | 97 | Feb. 10 | 93 |
| Feb. 16 | 94 | Feb. 17 | 93 |
| Feb. 23 | 97 | Feb. 24 | 97 |

| Year | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Year Avg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1945 | 91 | 95 | 97 | 97 | 96 | 96 | 86 | 90 | 91 | 97 | 95 | 85 | 93 |
| 1946 | *90* | | | | | | | | | | | | |

† Per cents of operation based on "Inch-Hours" reported to the National Paperboard Assn.



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# Potentiometric Determination of Sodium Sulphide in Sulphate Pulp Black Liquor*

By P. B. Borlew[1] and T. A. Pascoe[2]

**Abstract**

*The high sodium glass electrode can be successfully employed for argentimetric determinations of inorganic monosulphide if the concentration of S—ions in the half-cell is 0.01 normal or better. The data are confirmed by the carbon dioxide evolumetric method of the authors.*

*The potentiometric method described permits a rapid and direct determination of the $Na_2S$ content in sulphate black liquor without interference from organic sulphides and other substances usually present.*

*Samples of sulphate black liquor can be stored without decomposition in the absence of air and under low temperature conditions.*

*The consumption of $Na_2S$ in kraft cooks reaches a maximum in a comparatively early stage of the cook and practically ceases from then on. The $Na_2S$ consumption appears to be a relatively small part of the amount charged.*

*In combination with the known method of argentimetric titration of mercaptans the described potentiometric method permits the successive determination of inorganic monosulphide and mercaptans. This procedure, if applied to the analysis of kraft mill sewer effluent, may contribute to the problem of river pollution and its toxicity to fishlife.*

This investigation relates to a direct and rapid determination of inorganic monosulphide in aqueous alkaline medium in the presence of and without interference from mercaptans and other organic sulphides. It extends the use of the so-called high sodium glass electrode to the analysis of black liquor from sulphate pulp manufacture. Finally it provides a simple method for evaluating the actual consumption of sodium sulphide during a kraft pulp cook, thus contributing a tool to use in obtaining some fundamental knowledge of the chemistry of that process.

Stevens and Wooldridge *(1)* noted that the problem of sulphate black liquor is a difficult one for the analyst. Because of the presence of low boiling point mercaptans and organic sulphides, evolution methods *(2, 3, 4)* are unsatisfactory, while methods requiring preliminary chemical separation *(5, 6)* or selective absorption methods *(7, 8, 9)* were found to be time-consuming and cumbersome. In surveying the literature it was recollected that the petroleum industry had to cope with a very similar analytical problem as a result of the "sweetening" operation. This is essentially a desulphurizing of gasoline by extracting it with a strong caustic solution. These alkaline extracts contain essentially the same constituents, NaOH, $Na_2S$, mercaptans, and organic sulphides, as black liquor except for the lignin and some other organic components. It was also learned that some laboratories in the petroleum industry were using a potentiometric method for determining $Na_2S$ and mercaptans by precipitating with $AgNO_3$ in strongly alkaline aqueous solutions. These methods were partly based on publications of Tamele and co-workers *(10, 11)* and were more recently supplemented by the application of a glass electrode to the problem by Lykken and Tuemmler *(12)*. The latter publication mentions the fact that sulphide and mercaptan ions can be potentiometrically titrated by using 0.1 *N* $AgNO_3$ as the titrant in 1.0 *N* NaOH plus 0.05 *N* $NH_4OH$ as a medium and by using a $Ag_2S$ or Ag indicator electrode. However, Lykken and Tuemmler do not make any observation as to the optimum concentrations of sulphide ions that should be present or the probable error to be expected by deviating from such concentrations.

Different metallic electrodes have been suggested *(1, 13)* for electrometric titrations of black liquor with standard acid solutions. Recently glass elec-

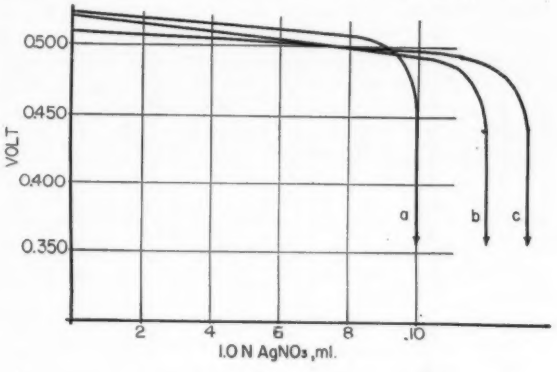


FIG. 1
Potentiometric Titration Curves of $Na_2S$ in: a—Sodium Sulphide Solution. b—Black Liquor. c—White Liquor. As per Table I

* Presented at the Annual Meeting of the Technical Association of the Pulp and Paper Industry, Hotel Commodore, New York, N. Y., Feb. 25-28, 1946.

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March 7, 1946

TABLE I.—SHOWING RESULTS FROM ANALYSIS OF VARIOUS $Na_2S$ LIQUORS USING A HALF-CELL CONCENTRATION GREATER THAN 0.1 *N* IN $Na_2S$

| | Potentiometric Method | | | Evolumetric Method | | | | |
|---|---|---|---|---|---|---|---|---|
| Description of Samples | Size Sample Tested, ml. | 1.0 *N* $AgNO_3$ Consumed, ml. | $Na_2S$ Found, g. | Size Sample Tested, ml. | 0.1 *N* Iodine Consumed, ml. | $Na_2S$ Found, g. | Equivalent $Na_2S$ for Half-Cell | Recovery, % |
| $Na_2S$, analytical reagent | 100.0 | 9.93 | 0.3873 | 20.0 | 19.70 | 0.0768 | 0.3840 | 100.8 |
| $Na_2S$, analytical reagent | 50.0 | 4.87 | 0.1899 | 25.0 | 24.25 | 0.0946 | 0.1891 | 100.3 |
| Sulphate white liquor | 10.0 | 13.18 | 0.5140 | 2.5 | 3.31 | 0.1291 | 0.5164 | 99.5 |
| (a) Black liquor | 50.0 | 11.97 | 0.4668 | ... | ... | ... | ..... | .... |
| (b) $Na_2S$, analytical reagent | .... | .... | ..... | 10.0 | 19.90 | 0.0776 | ..... | .... |
| (a) + (b) (a) | 25.0 | | | | | | | |
| (b) | 20.0 | 10.05 | 0.3920 | ... | .... | ..... | 0.3886 | 100.8 |
| (a) Black liquor | 50.0 | 13.28 | 0.5180 | ... | .... | ..... | ..... | .... |
| (b) $Na_2S$, analytical reagent | .... | .... | ..... | 20.0 | 17.67 | 0.0752 | ..... | .... |
| (a) + (b) (a) | 25.0 | .... | ..... | | | | | |
| (b) | 20.0 | 8.48 | 0.3307 | ... | .... | ..... | 0.3342 | 99.0 |
| (a) Black liquor | 50.0 | 9.62 | 0.3752 | ... | .... | ..... | ..... | .... |
| (b) $Na_2S$, analytical reagent | .... | .... | ..... | 25.0 | 21.20 | 0.0828 | ..... | .... |
| (a) + (b) (a) | 50.0 | .... | ..... | | | | | |
| (b) | 25.0 | 11.72 | 0.4578 | ... | .... | ..... | 0.4570 | 100.2 |
| (a) Black liquor | 25.0 | 11.23 | 0.4380 | ... | .... | ..... | ..... | .... |
| (b) White liquor | .... | .... | ..... | 2.5 | 29.40 | 0.1147 | ..... | .... |
| (a) + (b) (a) | 25.0 | .... | ..... | | | | | |
| (b) | 2.5 | 14.29 | 0.5573 | ... | .... | ..... | 0.5527 | 100.8 |

trodes have been suggested for such alkalimetric titrations *(14, 15, 16, 21)*; however, there is so far no suggestion in the literature regarding the use of the glass electrode for a direct sulphide determination in black liquor by precipitation with $AgNO_3$. It is conceivable that the commercial availability of a glass electrode suitable for permanent use in a highly alkaline medium had to precede that development.

While the present investigation was in progress, Cary and Baxter *(17)* disclosed that 1.0 *N* NaOH is particularly suited for the storage and renewing of glass electrodes that are to be used for measuring electromotive force in strongly alkaline solutions. This has been confirmed by our own findings to the effect that the asymmetry potential of a high pH glass electrode (Beckman Type 1190-E) can be reduced to a minimum of a few millivolts by conditioning and storing it in 1.0 *N* NaOH solution. It has been found over extended time intervals that such an electrode requires scarcely any electrical compensation as performed by the zero adjuster of the Beckman potentiometer when measuring a standard buffer of pH 12.

The fact that this potentiometric analysis is carried out in strongly alkaline medium precludes the formation of NaHS from $Na_2S$ present. The pH level is far above the ceiling of 8.3 necessary for the existence of NaHS. It must also be emphasized that the high pH (12.0 to 13.0) of sulphate black liquor excludes the presence of HS-ions. This is contrary to popular opinion. Thus the determination of sulphide in black liquor in a strongly alkaline medium gives considerable assurance of obtaining correct results.

Most of the interfering substances which might be present in sulphate black liquor form ammonia soluble sulphides. Willard and Fenwick *(18)* proved experimentally that the electrometric endpoint in the precipitation of sulphide by an ammoniacal silver nitrate solution is extremely sharp and accurate even in the presence of sulphite, sulphate, chloride, thiosulphate, and polysulphide. Tamele and Ryland *(10)* pointed out that diethyldisulphide does not form a precipitate with silver nitrate. No statement in the literature could be found that would indicate that dimethyl sulphide would form a precipitate with silver nitrate. It would seem reasonably safe to assume that this common constituent of black liquor would not interfere.

In the opinion of Kolthoff and Furman *(19)* the potentiometric method (Müller) for the titration of sulphide with silver nitrate gives good results, especially when the sulphide solution is more concentrated than 0.02 *N*. These authors found erroneous low results in the titration of very dilute solutions. They report that in the titration of 0.0001 *N* sulphide solutions, the negative error can amount to 10%.

It appears from our experiments that Kolthoff and Furman's findings are also fundamentally valid for the glass electrode. It seems that the error-free range could be extended downward to a somewhat lower concentration by substituting the glass electrode for metallic electrodes. However, in some cases it might be impossible to raise the concentration of the half-cell to the optimum concentration.

### Apparatus and Procedure

The apparatus used by the authors consisted of a calibrated standard Beckman portable pH meter, a shielded high sodium, blue point glass electrode, and a specially prepared silver sulphide indicator electrode. The latter was a silver wire soldered to a discarded Beckman glass electrode from which the glass part had been removed. The silver wire was pulled through the small end of a paraffin filled medicine dropper in such a way that the other end of the dropper enclosed the soldered connection. Both ends were then sealed with paraffin or any other alkali resistant dielectric material. The protruding part of the silver wire was wound into a spiral about 1 inch long, 0.5 inch in diameter (about 4 or 5 turns). The indicator electrode was electrolytically coated with a layer of AgS from a saturated aqueous solution of $Na_2S$. The indicator electrode served as the anode, a silver wire as the cathode, and a dry cell was used as a current source. The indicator electrode should be polished with emery paper and cleaned before plating. After the operation the prepared electrode should be rinsed thoroughly with and kept in water to prevent any silver oxide formation. The coating operation should be repeated at least once a week.

In the apparatus used the half-cell was prepared by adding caustic and ammonia in such amounts that the final volume of 500 ml. would be 1.0 *N* in NaOH and 0.05 *N* in $NH_4OH$. After adding a portion of the diluting distilled water and cooling, the sample was added and the whole made up to volume.

The literature on sulphate black liquor frequently mentions its "instability" and the apparent changes in $Na_2S$ content of stored black liquor samples *(2, 3, 9)*. Contrary to these, it was found that if the sample is stored under proper conditions such as rigid exclusion of air and low temperature, preferably not higher than a few degrees above freezing temperature, the $Na_2S$, viz., $H_2S$ content, appeared to remain quite constant over several weeks. The detrimental influ-

TABLE II.—SHOWING RESULTS FROM ANALYSIS OF VARIOUS $Na_2S$ LIQUORS USING A HALF-CELL CONCENTRATION LESS THAN 0.005 *N* IN $Na_2S$

| Description of Samples | Potentiometric Method: Size Sample Tested, ml. | Potentiometric Method: 0.1 *N* $AgNO_3$ Consumed, ml. | Potentiometric Method: $Na_2S$ Found, g. | Evolumetric Method: Size Sample Tested, ml. | Evolumetric Method: 0.1 *N* Iodine Consumed, ml. | Evolumetric Method: $Na_2S$ Found, g. | Evolumetric Method: Equivalent $Na_2S$ for Half-Cell | Recovery, % |
|---|---|---|---|---|---|---|---|---|
| $Na_2S$, analytical reagent | 50.0 | 27.50 | 0.1072 | 25.0 | 14.75 | 0.5750 | 0.1150 | 93.2 |
| $Na_2S$, analytical reagent | 50.0 | 26.50 | 0.1032 | 25.0 | 14.75 | 0.5750 | 0.1150 | 90.0 |
| Sulphate white liquor | 1.25 | 14.30 | 0.0558 | 1.25 | 15.90 | 0.0621 | 0.0621 | 90.0 |
| | 1.00 | 12.00 | 0.0468 | 1.00 | 12.90 | 0.0503 | 0.0603 | 93.1 |
| (a) Black liquor | 10.0 | 12.30 | 0.0480 | ... | .... | ..... | ..... | .... |
| (b) $Na_2S$, analytical reagent | .... | .... | ..... | 25.0 | 21.30 | 0.0831 | ..... | .... |
| (a) + (b) (a) | 10.0 | .... | ..... | | | | | |
| (b) | 10.0 | 19.65 | 0.0766 | ... | .... | ..... | 0.0826 | 92.6 |

ence of air has been mentioned previously in the literature *(2, 3, 9, 15)*. However, it seems that the temperature factor has escaped the attention of previous investigators. An ordinary mechanical refrigerator might well serve this purpose. In order to run duplicate or triplicate analyses, it is advisable to subdivide a given sample and fill a sufficient number of small glass stoppered bottles. If only a part of the contents is used, the unused part should be discarded.

In all analyses except those on black liquor itself, the results from the potentiometric method were checked using the carbon dioxide evolution method previously described by the authors *(4)*.

## Presentation of Results

Table I shows the results obtained in accounting for the $Na_2S$ content of various solutions when using the optimum sulphide concentration. Figure 1 shows some of the titration curves obtained in determining the $Na_2S$ content of three of the same liquors in Table I. In Table II similar data are shown using lower than optimum sulphide concentration. Table III shows the results from several tests on different

TABLE III.—SHOWING TESTS FOR STABILITY OF SULPHATE BLACK LIQUOR

| | Sample Tested, ml. | $AgNO_3$ Consumed, ml. | $Na_2S$ Found, g./liter |
|---|---|---|---|
| Sample A, as collected | 10.0 | 6.15; 0.2 *N* | 4.80 |
| 2 days later | 20.0 | 12.60; 0.2 *N* | 4.90 |
| Sample B, as collected | 2.5 | 6.10; 0.1 *N* | 9.50 |
| 3 days later | 5.0 | 12.50; 0.1 *N* | 9.75 |
| Sample C, as collected | 5.0 | 22.10; 0.1 *N* | 17.20 |
| 3 days later | 2.5 | 10.85; 0.1 *N* | 16.90 |
| 4 days later | 3.1 | 13.70; 0.1 *N* | 17.10 |
| Sample D, as collected | 20.0 | 11.30; 0.2 *N* | 44.4 |
| 6 days later | 10.0 | 11.60; 0.2 *N* | 4.53 |

black liquor samples immediately after collection and after storage. Table IV shows typical results obtained in following the consumption of $Na_2S$ during a mill-scale kraft cook.

The results from the analyses of the first two different liquors containing sulphide shown in Table I could be checked by the the independent evolution method. The results on black liquors could only be confirmed by the addition of known quantities of $Na_2S$ or white liquor and by determining the recovery of the same in the mixture. In all cases the agreement is very satisfactory.

Figure 1 shows that the break at the endpoint is unmistakable and the approach to the endpoint is marked sufficiently by increasing drops in the potential so as to warn of the inflection. The inflection potential was found to occur at about —0.420 volt, which is in fairly good agreement with —0.400 volt established by Kolthoff and Verzijl *(20)*. In order not to dilute unnecessarily the concentration of the half-cell it was found advisable to titrate as far as possible with 1.0 *N* $AgNO_3$ and finish up with 0.1 *N* $AgNO_3$. However, it should be mentioned that the use of 1.0 *N* $AgNO_3$ may result in a coarse grained precipitate that tends to become lodged in the spiral electrode causing irregularities in the galvanometer deflections. This latter difficulty could probably be avoided by improving the design of the apparatus. In the apparatus employed it was minimized by regulation of the rate of titration and stirring and by tapping the indicator electrode.

The data in Table II were obtained by following the same general plan as above except for the concentration of sulphide and in some cases the normality of $AgNO_3$. These results show the consistent negative error that is present as a result of using the lower sulphide concentration. This information is included to show that in case of certain dilute liquors, such as pulp mill sewer effluents, the method would still yield results of considerable value. This statement is made because it is felt that in view of the lack of any other suitable method, results 10% in error are better than none. The advantage of a rapid and direct determination of $Na_2S$ contents of sulphate black liquors with a glass electrode and portable potentiometer certainly justifies its application even to substandard concentrations if a theoretically possible accuracy is not essential. The further application of the method to the analysis of liquids in this lower range of concentration is being investigated at present.

The results shown in Table III were obtained using the electrometric method. They indicate that black liquor can be stored with the proper precautions without appreciable change in the $Na_2S$ content.

The information in Table IV shows that with the present method it is practical to follow the consumption of the $Na_2S$ in the cooking liquor as the cook progresses. These data seem typical for experimental and mill-scale cooks. In view of many conflicting and speculative opinions still current on the subject of kraft cooking the presented data contribute some light to the rather obscure knowledge of the chemistry of that process. The information obtained to date indicates that the major portion of the $Na_2S$ is consumed early in the cooking cycle. The consumption during the latter stage of the cooks is negligible. Further work is in progress to determine the possible practical importance of information of this nature.

## Acknowledgment

Acknowledgement is made of the assistance rendered by a number of the Technical Staff during this investigation. The authors are grateful to Nekoosa-

TABLE IV.—SHOWING DIRECT POTENTIOMETRIC DETERMINATION OF THE CONSUMPTION OF SODIUM SULPHIDE IN A MILL-SCALE KRAFT PULP COOK

| Time of Sampling From Beginning of Cook, minutes | Size Sample Used, ml. | 1.0 *N* $AgNO_3$ Consumed | Concentration of $Na_2S$ in Digester, g./liter | Consumption of $Na_2S$: g./liter | Consumption of $Na_2S$: Per Cent of Initial Amount |
|---|---|---|---|---|---|
| 0 | 10.0 | 7.93 | 30.9 | ... | ... |
| 30 | 20.0 | 11.86 | 23.2 | 7.7 | 24.9 |
| 45 | 20.0 | 12.24 | 23.8 | 7.1 | 22.9 |
| 90 | 20.0 | 11.58 | 22.6 | 8.3 | 26.9 |
| 120 | 25.0 | 14.00 | 21.8 | 8.1 | 29.4 |

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## TAPPI Notes

The TAPPI New England Section will meet at the Roger Smith Hotel, Holyoke, Mass., on Friday evening, March 22nd at 6:30 p.m. H. G. Rappolt of the J. O. Ross Engineering Corporation will talk on New Developments in Drying Equipment for the Coating of Paper.

R. A. Wilkins is now manufacturing manager of Bird & Son, Inc., East Walpole, Mass.

The F. G. Findley Company is now located at 3033 W. Pemberton Ave., Milwaukee, 10, Wis.

The Certificate of Appreciation of the Quartermaster Subsistence Research and Development Laboratory of the U. S. Quartermaster Corps was recently awarded to R. G. Macdonald, Secretary of the Technical Association for personal services to the Chicago Quartermaster Depot during World War II.

Erik F. Kruse, chief chemist for the United Paper Mills, Copenhagen, Denmark and Brynolf Lundquist, technical manager of M. Peterson & Son, Moss, Norway are visiting the United States.

The TAPPI Massachusetts Institute of Technology Group met at the Engineers Club, New York, N. Y., on Tuesday, February 26th. R. W. Van Kirk of Penick & Ford Sales Company presided. A brief address was made by George E. Dandrow, Vice President of the Johns-Manville Company. Hermon T. Barker of Bird & Son, East Walpole, Mass., was elected chairman. Past chairmen present included Allen Abrams, Marathon Corporation, John L. Parsons, Hollingsworth & Whitney Co., and S. W. Fletcher, J. O. Ross Engineering Co. About 40 attended.

The TAPPI University of Maine, New York State College of Forestry and Institute of Paper Chemistry group met during the convention.

The Watertown Group of the TAPPI Empire State Section will meet at the Hotel Woodruff, Watertown, N. Y. on March 14th. A motion picture "Machine Knives in Industry" will be presented through the courtesy of the Simonds Saw and Steel Company of Fitchburg, Mass. Ralph Gilchrest, assistant superintendent of the Simonds plant will be present to comment and answer questions.

Correction, TAPPI Suggested Method T 629 sm-44, Analysis of Sulphite Waste Liquor: The second note near the bottom of the second column on the back of sheet 2 states, "Lignin may also be calculated by determining the methoxyl content of the total solids of the sulphite liquor by *multiplying* the weight of methoxyl by 0.128. The word *dividing* should be substituted for *multiplying*.

The TAPPI Delaware Valley Section meeting scheduled for March 1st has been postponed to March 8th at the Engineers Club, Philadelphia, Pa. The principal speaker will be John Cornell, publisher of the Paper Mill News.

The Western New York Group of the TAPPI Empire State Section will meet jointly with the Niagara Branch of the C. P. P. A. Technical Section at the General Brock Hotel, Niagara Falls, Ontario on Wednesday, March 13th. Trevor Potts of the Imperial Chemical Industries will talk on wartime papermaking in England.

The Lake States Section will meet at the American Legion Club House, Appleton, Wis., on Tuesday, March 12, at 6:30 P.M. G. K. Dickerman of the Consolidated Water Power and Paper Company and John McGovern of the Forest Products Laboratory will talk on the German Pulp and Paper Industry as seen in 1945.

## Material Trade Names

The Industrial Research Service has just issued its 1946 edition of the Handbook of Material Trade Names (503 pp. 6 x 9 in.) by O. T. Zimmerman, professor of chemical engineering, University of New Hampshire and Irvin Lavine, formerly of the University of North Dakota. This is a very useful book for purchasing agents, technical men and mill managers. Since a large proportion of materials that are bought by industry reach the mills under a trade name that often gives no indication as to the nature of the product, this book will help to clear up in a convenient way information concerning the composition, properties and source of supply of several thousand materials. It should prove of value to manufacturers.

The list of materials is shown alphabetically with an average of ten to a page for 503 pages. A directory of suppliers is also given. An example of how a material is described is as follows:

Hamp Wax: A group of hard amorphous petroleum waxes of the grease-proof type, possessing very high resistance to moisture vapor transmission. Uses: As a substitute for microcrystalline waxes; in the manufacture of ordnance paper, and similar applications; and for waterproofing bags used for export shipment (Witco Chemical Co.)

Copies may be obtained from the Book Department of the Technical Association of the Pulp and Paper Industry, 122 East 42nd Street, New York 17, N. Y. at $7.50 per copy.

# A Method for Ascertaining the Rate of Drying of Paper and Paperboard Under Machine Conditions*

By Victor S. Burstein[1]


## Abstract

*From an experimental study of the drying of paper on a laboratory apparatus, the following implications are drawn concerning the operation and design of paper machines:*

*(a) The thermal resistance of a vapor layer formed between the sheet and the drier is considerable. The thickness of this layer with the present paper machine design is governed only by the tension in the paper web and in the drier felt. Increasing the tension of the drier felt is not feasible because of the strain on the felt rolls and on the seam of the felt.*

*(b) The extent to which increased turbulence and decreased relative humidity of the atmosphere in the drier section can increase the drying rate is limited. The temperature of the air is, no doubt, of considerable importance in determining the amount of heat lost from the driers, sheet, and felt.*

*(c) Increased drying rates are obtained with increased drier temperature in a linear relation up to temperatures such that the free water in the sheet reaches 212°F. Further increases in drier temperature above this point result in lesser increases of drying rate. This critical drier temperature is probably well above 250°F. in most practical cases. It will be lower with lower drying rates, with higher thermal conductivity of the dry paper, and with thinner vapor layers between the drier and the sheet.*


Numerous theories have been proposed to account for the flow of heat in the drying of paper or paperboard with steam-heated driers, and the transit of vapor from the sheet to the atmosphere. Vast differences in rate of evaporation have been reported and accessories to the drying systems in use seem to be based upon widely different theories concerning the mechanism of drying or at least the relative importance of various factors involved. With a view of learning more about the mechanism involved and, if possible, to establish quantitative factors useful in the design and operation of paper-machine drying systems, a thorough search of the literature was made and an apparatus was designed to simulate, as far as possible on a laboratory scale, the cycle through which paper passes in progressing from one end of a section of conventional paper-machine driers to the other.

## Description of the Apparatus

### Special Apparatus

The following apparatus was designed and constructed to dry handsheets by a process similar to paper-machine operation. Figure 1 is a plan view of the entire apparatus, Fig. 2 is a plan view of the main moving parts, and Fig. 3 is an elevation showing the main moving parts.

In this apparatus a handsheet (heavy dotted line, (17) in Fig. 1) was suspended from a fixed clamp (40). It was contacted, first on one side and then on the other, by heated, machined, cast-iron surfaces (16, 16′). As each drier surface contacted the sheet, a "felt**" was brought up to hold the sheets against the drier. Thus, the conditions of machine drying wherein the paper passes over one drier and under the next drier were simulated.

The combination of the wheel (4), the carriage (6), the rod (7, 7′), and the plate (8) was necessary to position the driers (16, 16′). As wheel (4) revolved, the carriage (6) traveled back and forth. The frame (14) was rigidly connected to the plate (8) through the rod (10). This assembly traveled in a direction perpendicular to that of the carriage (6). The rod (7, 7′) acted as a cam to position plate (8).

The framework consisted of two tables (13) with rails (15) between them. A sheet of galvanized iron (38), in the middle of which was a well (49), was fastened above the rails. In Fig. 2 this sheet and well are removed. The handsheet (17) was suspended from a clamp (40) and was under tension from the weight of a bottom clamp. The clamps and the sheet were placed in position through the well.

A wheeled frame (14) carrying two castings (16, 16′) rolled on the rails (15)***. The surfaces of the castings which faced the paper were machined to a radius of 24 inches. The castings were hollow, and oil was circulated by the pump (27) through the castings from the reservoir (25). The oil was heated in the reservoir by electric coils (33) under thermostatic control (34). Circulation in the reservoir was obtained by the by-pass (29). The oil was carried to and from the castings in pipes (28, 31), each pipe ending in flexible metal tubes. The flow of oil to the castings could be regulated by valves in the lines (28, 29), and could be measured by directing the return flow in the line (31) through the spout (32) by means of a three-way cock.

Provisions were made for directing air against the surfaces of the paper. The air entered the baffled chambers (39) through the tubes (35), and passed through slits into the space between the driers.

Two "felts" (41, 41′) were suspended from levers (42, 42′) which were pivoted near the bottom edges of the castings. The complete motion was accomplished as follows: Wheel (4) was turned by the belt

*Presented by title at the Annual Meeting of the Technical Association of the Pulp & Paper Industry, Hotel Commodore, New York, N. Y., Feb. 25-28, 1946.

A portion of a thesis submitted in partial fulfillment of the requirements of The Institute of Paper Chemistry for the degree of Doctor of Philosophy from Lawrence College, Appleton, Wisconsin, March, 1944. This work was carried out under the direction of Sidney D. Wells.

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** In order to eliminate variations of porosity, moisture content, and capillarity in the "felt," pieces of Fourdrinier wire were used instead of canvas.

*** When the apparatus was operated, the assembly suspended from the frame (14) was enclosed with insulating board.

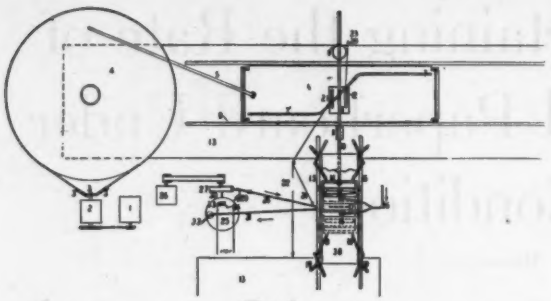

FIG. 1
**Apparatus for Experimental Drying (Plan View of Entire Apparatus)**

which passed over idler pulleys (3′) and pulley (3). The motor (1) drove the automobile transmission (2) which drove pulley (3). The wheel (4) was connected by the rod (5) to the carriage (6) which traveled between guides (9). Mounted on the carriage (6) was a bent rod (7, 7′) which positioned the plate (8) and the pins (12, 21) which ran in slots in the plate (8).

As wheel (4) turned counter-clockwise from the position of Fig. 1, the right hand portion of the rod (7) moved to a position under the plate (8). The plate was thereby moved toward the bearing (11′). This motion was transferred to the frame (14) through the rod (10) attached to the plate (8) and sliding in bearings (11, 11′). The surface of the casting (16) was thereby brought against the paper (17).

Wires (43) were fastened to the table (13) and to the felt levers (42). Hence, as the casting (16) moved away from the table, the wires brought up the felt levers. The wire (24) passed through a fixed pulley near the floor and was attached to the pin (21). The same motion that carried casting (16) away from the table (13) carried the pin (21) away from this fixed pulley through which wire (24) passed. Consequently, this motion caused wire (24) to pull down on wires (43), thus decreasing the effective lengths of wires (43). The result of the action of wire (24) was to bring up the levers (42) with sufficient rapidity. The spring in the connection of wire (24) insured a positive pressure of the top of the felt (41) against the paper.

The entire handsheet (17) was pressed against the drier by the felt (41). The roller (48) was moved to the left by the pin (21) acting through wire (22), center-pivoted lever (46), and wire (45). The roller (48) pulled the bottom part of the felt (41) to the left, and the paper (17) was therefore pressed to the drier. The felt action was completed shortly after the drier contacted the top of the paper because pin (21) ran in a slot of plate (8) and, therefore, its motion lagged behind that of the plate.

As the wheel (4) approached the neutral position again (180° from the position shown in Fig. 1), the felt (41) dropped away from the paper when the bent part of the rod (7) reached the pin (21). An instant later the bent part of the rod reached the positioning pins of plate (8) and the frame (14) was pulled to the left by the springs (18). Springs (19) then pulled the stiff springs (18) from the path of the frame (14).

As the wheel (4) continued in its counter-clockwise revolution, the carriage (6) brought the left hand portion of the rod (7′) beneath the plate (8) so that the surface of casting (16′) contacted the paper (17). At the same time the felt (41′) was brought against the paper by the action of wires (43′) on the levers (42′), and the simultaneous action of wire (23) on wires (43′). Roller (48) was pulled to the right by wires (45′, 20). Wires (20) and (23) passed under the right hand table (13) and over fixed pulleys to the pin (12) which acted in a slot in plate (8).

DETAILS OF SPECIAL APPARATUS

| | |
|---|---|
| Faces of castings (16, 16′) | 8 × 6 inches |
| Plywood wheel (4) | 50 inch diameter |
| Plywood carriage (6) | 60 × 20 inches |
| Rod (7, 7′)—¾-inch key stock | see below |
| Pins in plate (8) straddling rod (7, 7′)—high tensile steel | ¼ inch diameter |
| Cold rolled shafting connecting plate (8) and frame (14) | ½ inch diameter |
| Piano wires actuating felts | No. 20 |
| Total travel of frame (14); also distance between drier surfaces (16, 16′) | 9¼ inches |
| Radius * of path of pin connecting rod (5) to wheel (4) | 14½ inches |
| Motor (1) | ⅓ horsepower |
| Pipes for oil | 1 inch and ¾ inch |
| Oil pump | |
| Motor for oil pump | ¼ horsepower |

* Variable.

Details of rod (7, 7′)

The shape of the rod (7, 7′) is shown in Fig. 4. This rod acted as a cam to position plate (8) and the pins in the slots of plate (8). The extreme positions of the plate and the pins were determined by the segments $AB$ and $EF$ running parallel to the direction of motion of the carriage (6). The segment $CD$ was at a 45° angle with the motion of the carriage. The curved segments $BC$ and $DE$ were of 3.5-inch radius.

CALCULATIONS FOR THE DESIGN OF THE SPECIAL APPARATUS

The acceleration and deceleration of plate (8) (Fig. 1) takes place when the curved parts of the rod (7, 7′) pass under the plate. The curved parts referred to above are the segments $BC$ and $DE$ in Fig. 4. When the slanted part of the rod, $CD$, passes under plate (8), the plate takes on a speed equal to that of carriage (6) because the angle of the slanted part is 45°.

Considering the ordinates drawn as dotted lines in Fig. 4, the equation for the segment $BC$ is:

$$y = R - (R^2 - x^2)^{1/2}.$$

Differentiating in respect to time:

$$dy/dt = -1/2(R^2 - x^2)^{-1/2}(-2x)\,dx/dt$$
$$= x(R^2 - x^2)^{-1/2}\,dx/dt.$$

The quantity $(dx/dt)$ is the velocity of the carriage (6), and will be referred to as $V_x$. Considerable force is necessary to move plate (8) because of the mass of the castings (16, 16′) which move with it. This force will act to momentarily slow the motion of the carriage (6) because of belt slippage at the wheel (4). If this slippage is such that the velocity $V_x$ is constant for the distance along $BC$, then the equation can be differentiated a second time as follows:

$$d^2x/dt^2 = V^2_x\,[x^2(R^2 - x^2)^{-3/2} + (R^2 - x^2)^{-1/2}]$$

At point $B$ in Fig. 4,

$$x = 0;\ d^2x/dt^2 = V^2_x/R$$

At point $C$ in Fig. 4,

$$dy/dx = 1.0;\ x = 0.707R;\ d^2x/dt^2 = 2.83\ V^2_x/R$$

The weight of the assembly suspended from the frame (14) was about 40 pounds. The radius ($R$)

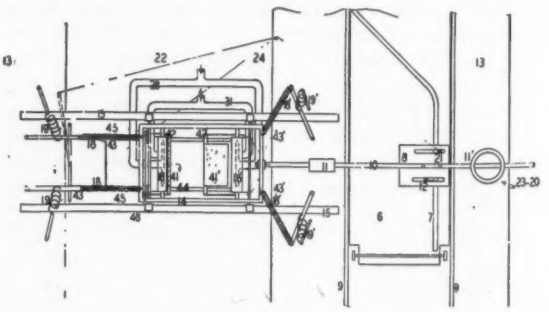

FIG. 2
**Apparatus for Experimental Drying (Plan View of Main Moving Parts)**

in the above equations was 0.292 feet. At 10 revolutions per minute of the wheel (4), the speed of the pin connecting the wheel to the rod (5) was

$$(10 \times 3.14 \times 29)/(60 \times 12) = 1.265 \text{ feet per second}$$

where the diameter of the path of the pin was 29 inches.

Substituting in the equation, $F = Ma$, where $F$ is the force at point $C$ of Fig. 4:

The force at point $B$ of Fig. 4:

$$F_b = [(40/32.2) \times 1.265^2]/0.292 = 6.8 \text{ pounds;}$$

the force at point $C$ of Fig. 4:

$$F_c = [(40/32.2) \times 2.83 \times 1.265^2]/0.292 = 19.2 \text{ pounds}$$

The force at point $B$ was an impact force. There were friction forces in addition to these inertia forces.

### Apparatus used in oven drying

A thermostatically controlled oven was used. Handsheets were suspended from a wire which ran through a hole in the top of the oven. This wire was suspended from one arm of an analytical balance which was placed on top of the oven. A weight was suspended by wires from the bottom of the sheet to prevent curling. Air was introduced into the oven at a constant rate through a perforated pipe at the bottom of the oven. The air was obtained from a compressed air line and passed through a pressure regulating device and a flow meter before entering the oven.

## Experimental Procedures and Conditions

### Procedure for making handsheets

Handsheets were made on the Noble and Wood sheet mold (8 by 8 inches). Each sheet was transferred from the wire to a new blotter by passing the blotter and the sheet on the wire through the Noble and Wood press with no added weights on the press roll. The sheet with the blotter was placed in the middle of a pile of several dry blotters and the pile was pressed at a definite pressure in a hand press.* The sheets were kept between wet blotters in a moistureproof box until the drying experiments were performed.

### Procedure for the special apparatus

The special apparatus was designed for a sheet 6 by 8 inches. A platen of this size was placed on the sheet and the excess strips were torn off. The bottom clamp for the sheet was then fastened to one of the 6-inch edges, and the sheet, together with the clamp, was placed in a tared can and weighed. The wet weight of the sheet $P_w$ was the difference between the total weight and the weight of the can plus the bottom clamp. The special apparatus was in the mid-position as shown in Fig. 1. The sheet together with the bottom clamp was then placed in the top clamp (40), the assembly was inserted in the well (49), and the motor (1) was started. After a definite time the motor was stopped with the apparatus in the mid-position and the clamp (40) was pulled up and suspended on the top

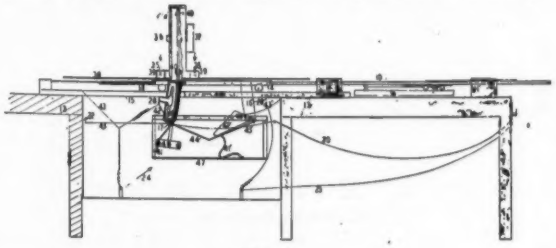

FIG. 3
Apparatus for Experimental Drying (Elevation Showing Main Moving Parts)

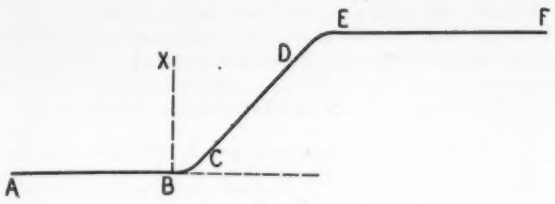


FIG. 4
Details of Roll 7, 7'

of the well (49) so that the sheet (17) was inside the well. In the center of each of the broad faces of the well was a 4½ inch circular hole. The top and bottom of a tared weighing can (36, 37) were inserted through these holes and pressed against the sheet so that a circular area the size of the weighing can was unexposed to the air when the sheet, together with the weighing can, was removed from the well. The sheet was torn around the edge of the weighing can.

The can and the enclosed sample were weighed. The net weight of the sample as it left the drier will be designated as $p_d$. The sample and the reminder of the sheet were dried on a hot plate and weighed separately. The moisture-free weight of the sample will be designated as $p_b$ and the moisture-free weight of the entire sheet, including the sample, will be designated as $P_b$.

The area of the sample was calculated as $48 \times p_b/P_b$ and the weight of the sample before drying was calculated as $P_w \times p_b/P_b$. The water removed per square inch was the difference between the original weight of the sample and its weight as it left the drier, divided by the area of the sample. Designating the water removed per square inch as $E_x$,

$$E_x = [(P_w \times p_b/P_b) - p_d]/48p_b/P_b$$

It was necessary to normalize the data to a constant initial moisture content so that a given value for "water removed per square inch" in any experiment would correspond to the same final moisture content. Such normalization was possible because the initial rate of water removal, designated as $R_o$, was constant for a given sheet. Therefore, if this rate were known, it was legitimate to add or subtract from $E_x$ if the corresponding correction to the time of drying were made. A value of $W_o$, the initial moisture content per unit area, was chosen for each set of experiments. The actual value of initial moisture content per unit area, $W_x$, was calculated as $(P_w - P_b)/48$. The algebraic value of $(W_o - W_x)$ was added to $E_x$ to give the corrected amount of evaporation. The corresponding correction to the time of drying was $(W_o - W_x)/R_o$.

### Procedure for oven drying

In the oven drying experiments the weight of the sheet was determined at intervals of 20 to 40 seconds while the sheet was being dried. After the experiment, the moisture-free weight of the sheet was determined.

The water in the sheet at any time was the difference between the weight of the sheet and the moisture-free weight. The average rate of drying between any two times was the difference between the sheet weights at the two times divided by the difference in time.

### Other procedures

The pulps used and the beating schedules are tabulated in Table I.

* The pressures were: 300 p.s.i. for 180-pound sheets; 150 p.s.i. for 90- and 45-pound sheets.

When the pulps were not beaten, they were "brushed out" in the beater for 5 minutes with 4500 grams on the bedplate. The bleached soda pulp was used only as a 50-50 mixture with the bleached kraft. A 75-25 groundwood-unbleached sulphite mixture was used.

TABLE I.—PULPS AND BEATING SCHEDULES

| Pulp | Source | Weight on Bedplate, g. | Beating Time, min. | Freeness, ml. S.R. |
|---|---|---|---|---|
| Bleached kraft | Middle West | 5500 | 45 | 630 |
| | | 4500 | 30 | 750 |
| Unbleached kraft | Middle West | | Not beaten | |
| Unbleached sulphite | Far West | 5500 | 30 | 630 |
| Bleached soda pulp | East | 4500 | 20 | 630 |
| Groundwood | Middle West | 325 | 60 | 200 |

The pulp designated as "Bauer mill" was prepared by passing bleached kraft pulp through a 36-inch, 1200 r.p.m. commercial Bauer pulper. Two passes were made at a consistency of 3.4% solids. The final freeness, after standing, was 380 ml. Schopper-Riegler.

Clay-filled sheets were prepared from a mixture of 165 grams of clay and 250 grams of unbeaten bleached kraft. It was thought that, with the relatively large amount of clay, reasonable retentions could be obtained without using the white water return system. However, the percentage ash in the sheets was only 3.0, 5.6, and 8.7 for sheets of a basis weight of 45, 90, and 180 pounds TAPPI ream size.

### Experimental conditions with the special apparatus

*Speed.* Four different speeds were available at the transmission (2 of Fig. 1). Only the lowest speed was used. Ten cycles (i.e., 20 contacts of the sheet wtih a drier surface) were made per minute with this gear ratio.

In a typical modern paper machine* with 60-inch driers, the paper is in contact with the drier over 122 inches of the circumference. The distance between the points of contact on adjacent driers is 37 inches. Thus, the paper travels 159 inches for each contact with a drier. Twenty contacts per minute would correspond to a speed of $20 \times 159/12$ or 265 feet per minute. With 48-inch driers the total path for one contact would be 127 inches and the corresponding speed would be 212 feet per minute.

*Time between driers.* The proportion of the time during which the sheet was not in contact with a drier surface could be varied by varying the position of the pin which connected rod (5) to wheel (4) in Fig. 1. If this pin were nearer the center of the wheel, the total travel of the carriage (6) would be less, and the time for the transition from one extreme position of plate (8) to the other would be a greater percentage of the total time. Hence, the time during which the sheet is out of contact with a drier would be greater.

The radius used for the pin connecting rod (5) to wheel (4) was 14.5 inches in all the experimental work. With this radius, the angle through which wheel (4) turned while the sheet was out of contact with a drier was determined to be 56°. Thus, the sheet was not in contact with a drier 56/180 or 31% of the time. In typical modern machines, the sheet is between driers only 20 to 22% of the time.

### Temperature of the drier surface

The temperatures of the drier surfaces were controlled by the temperature of the oil circulated in the casting. It was originally intended that the temperatures would be measured by thermocouples imbedded in the castings near the drying surface. However, these thermocouples proved to be unreliable. Therefore, the temperatures of the drier surfaces were determined before each experiment with a surface pyrometer. These values were reproducible to within 5°F. However, it is probable that the actual temperature of the drier surface was less when the sheet was being dried; although the drier surface temperatures were measured immediately after a heavy sheet had been partially dried in the apparatus, they were only 5°F. less than the original temperatures. The imbedded thermocouples also showed a drop of about 5°F. during any one experiment. Such a drop is reasonable in view of the fact that the heat capacity of the castings totalled about 1 B.t.u. per degree Fahrenheit, and that, with the heaviest sheet used, only 5 grams of water (corresponding to 11 B.t.u.) were evaporated.

In the presentation of the experimental results the "drier surface temperature" refers to the temperature determined with the surface pyrometer before the start of the experiment.

An attempt was made to measure the rate of heat transfer from the drier to the paper while the paper was being dried. For this purpose, resistance thermometers were placed near the outlet of the reservoir (30 in Fig. 1), and in the pipe (31) carrying oil from the castings. These resistances were incorporated into a Wheatstone bridge circuit so that the difference between the temperatures of the oil entering the castings and that leaving the castings would be indicated by the potential difference in the bridge. It was thought that the heat transfer involved in the drying of the sheet would be reflected as an increased temperature difference between the incoming and outgoing oil. The change in temperature difference was too small to be useful, however.

### Air conditions

Unfortunately, the condition of the air passing between the driers could not be controlled because of the strong convection current rising past the hot surface. The provisions for introducing air through slots in the chambers (39 of Fig. 3) were not sufficient to overcome the convection current. Time did not permit the installation of a more satisfactory system. The air of the room was between 50° and 70° F. during the experimental work.

### Conditions for oven drying

The oven was at 212°F. before the wet sheet was introduced. The temperatures during the actual drying of the sheet were between 194° and 212°F., the

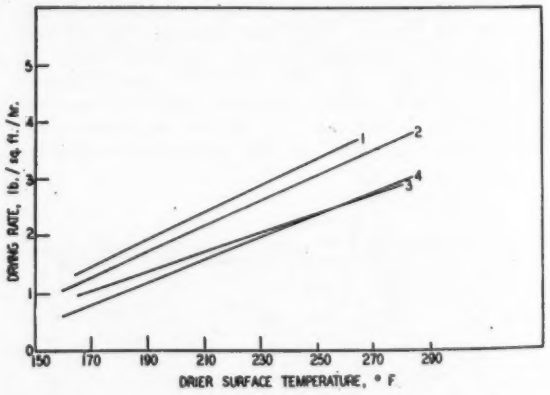


FIG. 5

First Constant Rate—1. Bleached Kraft, Unbeaten, 180-lb. Basis Weight; 2. Bleached Kraft, Beaten to 630 ml. S.R., 180-lb. Basis Weight; 3. Bleached Kraft, Unbeaten, 90-lb. Basis Weight; 4. Bleached Kraft, Beaten to 630 ml. S.R., 90-lb. Basis Weight

* The figures used for typical modern machines were calculated from design data furnished by the Beloit Iron Works.

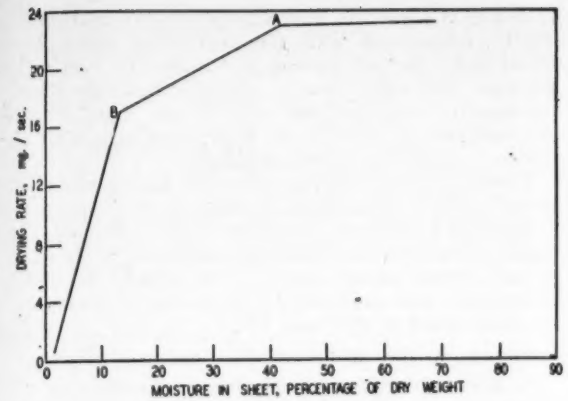


FIG. 6

**Typical Rate Curve, Oven Drying—Bleached Kraft-Soda (50:50), Beaten to 630 ml. S.R., 180-lb. Basis Weight**

temperature rising slowly within that range during the course of each experiment.

Air was introduced into the oven at the rate of 0.5 cubic foot per minute. The humidity of the air introduced was not controlled because the partial pressures within the range of ordinary humidities at room temperature correspond to inappreciable relative humidities at temperatures of 194° to 212°F.

### NOMENCLATURE

The following discussion will contain terms which are defined below:

Moisture contents are reported as percentages of moisture calculated on the dry weight of fiber.

The inner surface of the sheet refers to that surface momentarily in contact with the drier.

The outer surface of the sheet refers to that surface momentarily away from the drier.

Drier surface temperature refers to the temperature measured before each experiment. The actual temperature when the sheet was being dried was about 5° lower.

Dry layers refers to layers of the sheet in which the moisture content is below the fiber-saturation point.

Free water zone is the term for those zones in which the moisture content is above the fiber-saturation point.

Air films are discussed with the customary idealization of the sharpness of the boundary.

Critical moisture contents are moisture contents at which a break occurs in a curve.

Drying curves are curves for water removed versus drying time.

Rate curves are curves for drying rates versus percentage of moisture.

## Experimental Results

Complete and detailed presentation of the results are given in the doctor's dissertation "A method for ascertaining the rate of drying of paper and paperboard under machine conditions" by the writer. This dissertation is filed at The Institute of Paper Chemistry and is available for study or reference. The results showed that no significant difference existed between the rate of drying from one drier surface compared with the other when the temperature was the same.

The rate of drying was found to be constant through the first part of the drying cycle until the fiber saturation point was approximately reached. It then proceeded at a slower rate until the usual moisture content of dry paper—namely, approximately 6%—had been reached. In some papers a third rate, slower than the second, became manifest at moisture contents of approximately 10% or less.

Figure 5 shows the rates of drying bleached, beaten and unbeaten kraft papers of 180- and 90-pound basis weights, respectively. The observations on which the curves are compared were found to have a coefficient of variation of 4.4%. Tables II to IV give the observed results of various weights of paper of various characteristics.

**TABLE II.—RATE OF DRYING DURING FIRST CONSTANT RATE PERIOD**

(Pounds of water evaporated per square foot per hour)

| Basis weight (25 × 40—500) | 45 | 90 | 180 | 270 |
|---|---|---|---|---|
| (a) Bleached kraft—205° F. surface | | | | |
| Bauer mill (380 ml. S.R.) | 1.61 | 1.72 | 1.28 | |
| Beaten (630 ml. S.R.) | 2.24 | 1.67 | 1.47 | |
| Beaten (750 ml. S.R.) | 2.05 | 1.95 | 1.75 | 1.47 |
| Unbeaten | 2.56 | 2.08 | 1.65 | 1.45 |
| (b) Bleached kraft—240° F. surface | | | | |
| Bauer mill (380 ml. S.R.) | 3.32 | 2.97 | 2.29 | |
| Beaten (630 ml. S.R.) | 3.20 | 2.86 | 2.29 | |
| Unbeaten | 4.06 | 3.37 | 2.29 | |
| (c) Beaten to 630 ml. S.R.—240° F. surface | | | | |
| Bleached kraft | 3.20 | 2.86 | 2.29 | |
| Unbleached sulphite | | 2.80 | | |
| 75:25 groundwood-unbleached sulphite | | 2.69 | | |
| 50:50 soda-bleached kraft | 3.66 | 2.92 | 2.06 | |
| (d) Unbeaten—240° F. surface | | | | |
| Bleached kraft | 4.06 | 3.37 | 3.29 | |
| Bleached kraft plus clay | 4.46 | 3.43 | | |
| Unbleached kraft | 4.00 | 3.09 | 3.23 | |
| (e) Bleached kraft—630 ml. S.R. | | | | |
| 190° F. surface | 2.0 | 1.63 | | |
| 205° F. surface | 2.23 | 1.66 | 1.46 | |
| 240° F. surface | 3.2 | 2.86 | 2.29 | |
| 265° F. surface | | 3.26 | 2.29 | |
| (f) Bleached kraft—unbeaten | | | | |
| 150° F. surface | | 0.69 | | |
| 165° F. surface | 1.70 | 1.38 | 1.05 | 0.815 |
| 200° F. surface | | 1.95 | | |
| 205° F. surface | 2.48 | 2.06 | 1.65 | 1.43 |
| 225° F. surface | | 2.64 | | |
| 240° F. surface | 4.06 | 3.37 | 2.29 | 1.82 |
| 260° F. surface | | | 2.64 | |

**TABLE III.—RATE OF DRYING DURING SECOND CONSTANT RATE PERIOD**

(Pounds of water evaporated per square foot per hour)

| Basis weight (25 × 40—500) | 45 | 90 | 180 | 270 |
|---|---|---|---|---|
| (a) Bleached kraft—205° F. surface | | | | |
| Bauer mill (380 ml. S.R.) | 0.17 | 0.24 | 0.14 | |
| Beaten (630 ml. S.R.) | 0.17 | 0.46 | 0.57 | |
| Beaten (750 ml. S.R.) | 0.51 | 0.51 | 0.24 | 0.23 |
| (b) Bleached kraft—240° F. surface | | | | |
| Bauer mill (380 ml. S.R.) | 0.57 | 0.80 | 0.88 | |
| Beaten (630 ml. S.R.) | 0.40 | 0.97 | 0.69 | |
| Unbeaten | 0.23 | 0.69 | 0.80 | |
| (c) Beaten to 630 ml. S.R.—240° F. surface | | | | |
| Bleached kraft | 0.40 | 0.97 | 0.69 | |
| Unbleached sulphite | | 0.52 | | |
| 75:25 groundwood-unbleached sulphite | | 1.03 | | |
| 50:50 soda-bleached kraft | 0.69 | 1.03 | 0.46 | |
| (d) Unbeaten—240° F. surface | | | | |
| Bleached kraft | 0.23 | 0.69 | 0.80 | |
| Bleached kraft plus clay | 0.23 | 0.97 | | |
| Unbleached kraft | 0.40 | 0.86 | 0.34 | |
| (e) Bleached kraft—630 ml. S.R. | | | | |
| 190° F. surface | 0.80 | 0.43 | | |
| 205° F. surface | 0.17 | 0.46 | 0.57 | |
| 240° F. surface | 0.40 | 0.97 | 0.69 | |
| 265° F. surface | | 0.92 | 0.52 | |
| (f) Bleached kraft—unbeaten | | | | |
| 150° F. surface | | 0.34 | | |
| 165° F. surface | | | 0.56 | |
| 200° F. surface | | 0.40 | | |
| 225° F. surface | | 1.09 | | |
| 240° F. surface | | 0.69 | 0.80 | |

**TABLE IV.—CRITICAL MOISTURE CONTENTS WITH MACHINE DRYING**

(Expressed as percentage of the moisture-free weight)

| Basis weight (25 × 40—500) | 45 | 90 | 180 | 270 |
|---|---|---|---|---|
| (a) Bleached kraft—205° F. surface | | | | |
| Bauer mill (380 ml. S.R.) | 13.6 | 22.4 | 26.3 | |
| Beaten (630 ml. S.R.) | 15.3 | 25.7 | 35.0 | |
| Beaten (750 ml. S.R.) | 26.8 | 29.4 | 26.0 | 28.0 |
| (b) Bleached kraft—240° F. surface | | | | |
| Bauer mill (380 ml. S.R.) | 31.4 | 44.6 | 41.8 | |
| Beaten (630 ml. S.R.) | 23.4 | 31.6 | 38.3 | |
| Unbeaten | 11.3 | 25.4 | 31.9 | |
| (c) Beaten to 630 ml. S.R.—240° F. surface | | | | |
| Bleached kraft | 23.4 | 31.6 | 38.3 | |
| Unbleached sulphite | | 22.8 | | |
| 75:25 groundwood-unbleached sulphite | | 34.3 | | |
| 50:50 soda-bleached kraft | 27.2 | 42.2 | 22.3 | |
| (d) Unbeaten—240° F. surface | | | | |
| Bleached kraft | 11.3 | 25.4 | 31.9 | |
| Bleached kraft plus clay | 12.2 | 31.4 | | |
| Unbleached kraft | 13.8 | 21.5 | 17.7 | |

| | | | | |
|---|---|---|---|---|
| (e) Bleached kraft—630 ml. S.R. | | | | |
| 190° F. surface | 36.2 | 35.3 | | |
| 205° F. surface | 15.3 | 25.7 | 35.0 | |
| 240° F. surface | 23.4 | 31.6 | 38.3 | |
| 265° F. surface | | 32.3 | 24.5 | |
| (f) Bleached kraft—unbeaten | | | | |
| 150° F. surface | | 34.3 | | |
| 165° F. surface | | | 36.3 | |
| 200° F. surface | | 18.9 | | |
| 225° F. surface | | 40.5 | | |
| 240° F. surface | | 25.4 | 31.9 | |

Table V shows the over-all rate of drying for the papers indicated.

TABLE V.—OVER-ALL RATE OF DRYING IN DRYING FROM 100% TO 10% MOISTURE

(Pounds of water evaporated per square foot per hour)

| Basis weight (25 × 40—500) | 45 | 90 | 180 | 270 |
|---|---|---|---|---|
| (a) Bleached kraft—205° F. surface | | | | |
| Bauer mill (380 ml. S.R.) | 1.18 | 0.96 | 0.66 | |
| Beaten (630 ml. S.R.) | 1.35 | 1.10 | 0.98 | |
| Beaten (750 ml. S.R.) | 1.37 | 1.23 | 0.83 | 0.69 |
| (b) Bleached kraft—240° F. surface | | | | |
| Bauer mill (380 ml. S.R.) | 1.57 | 1.49 | 1.44 | |
| Beaten (630 ml. S.R.) | 1.56 | 1.91 | 1.28 | |
| Unbeaten | 3.30 | 2.02 | 1.60 | |
| (c) Beaten to 630 ml. S.R.—240° F. surface | | | | |
| Bleached kraft | 1.56 | 1.91 | 1.28 | |
| Unbleached sulphite | | 1.70 | | |
| 75:25 groundwood-unbleached sulphite | | 1.83 | | |
| 50:50 soda-bleached kraft | 1.99 | 1.80 | 1.34 | |
| (d) Unbeaten—240° F. surface | | | | |
| Bleached kraft | 3.3 | 2.02 | 1.6 | |
| Bleached kraft plus clay | 2.93 | 2.16 | | |
| Unbleached kraft | 2.93 | 2.30 | 1.58 | |
| (e) Bleached kraft—630 ml. S.R. | | | | |
| 190° F. surface | 1.40 | 0.93 | | |
| 205° F. surface | 1.35 | 1.10 | 0.98 | |
| 240° F. surface | 1.56 | 1.91 | 1.28 | |
| 265° F. surface | | 1.93 | 1.42 | |
| (f) Bleached kraft—unbeaten | | | | |
| 150° F. surface | | 0.54 | | |
| 165° F. surface | | | | |
| 200° F. surface | | 1.23 | | |
| 210° F. surface | | | 1.27 | |
| 225° F. surface | | 1.76 | | |
| 240° F. surface | | 2.02 | 1.60 | |
| 260° F. surface | | | 1.82 | |

The drying rates observed with oven drying are tabulated in Table VI. Figure 6 shows graphically typical results obtained with a 180-pound bleached kraft-soda (50-50) sheet. With a wet sheet, the drying proceeds at a constant rate independent of the thickness and other properties of the sheet. With the particular conditions employed, this rate was 0.197 pound of moisture per square foot per hour.

TABLE VI.—RESULTS WITH OVEN DRYING

(Characteristics of curves of drying rates versus percentage moisture content)

*First Critical Moisture Content*
(Percentage of dry fiber weight)

| Basis weight (25×40—500) | 45 | 90 | 180 |
|---|---|---|---|
| Bleached kraft—Bauer mill 380 ml. S.R. | 78* | 60** | |
| Beaten to 630 ml. S.R. | 55 | 42 | 28 |
| Unbeaten | 51 | 33 | 28 |
| Bleached kraft—unbeaten plus clay | 42 | 39 | 34 |
| Unbleached kraft—unbeaten | 52 | 36 | 36 |
| 50:50 bleached kraft-soda | | 39 | 40 |

*Second Critical Moisture Content*
(Percentage of dry fiber weight)

| | | | |
|---|---|---|---|
| Bleached kraft—Bauer mill 380 ml. S.R. | 36* | 16** | |
| Beaten to 630 ml. S.R. | 21 | 12 | 11 |
| Unbeaten | 18 | 10 | 8 |
| Bleached kraft—unbeaten plus clay | 21 | 14 | 10 |
| Unbleached kraft—unbeaten | 13 | 13 | 11 |
| 50:50 bleached kraft-soda | | 13 | 13 |

*Slope Between the First and Second Critical Moisture Contents*

| | * | 16* | ** | 14** | |
|---|---|---|---|---|---|
| Bleached kraft—Bauer mill 380 ml. S.R. | | | | | |
| Beaten to 630 ml. S.R. | 13 | | 28 | | 58 |
| Unbeaten | 13 | | 34 | | 51 |
| Bleached kraft—unbeaten plus clay | 17 | | 20 | | 32 |
| Unbleached kraft—unbeaten | 23 | | 25 | | 30 |
| 50:50 bleached kraft-soda | | | 25 | | 20 |

*Average Rate in Drying from Moisture Content of 20% to 5%—lb./sq. ft., hr.*

| | 0.058* | 0.070** | |
|---|---|---|---|
| Bleached kraft—Bauer mill 380 ml. S.R. | | | |
| Beaten to 630 ml. S.R. | 0.090 | 0.098 | 0.085 |
| Unbeaten | 0.117 | 0.093 | 0.110 |
| Bleached kraft—unbeaten plus clay | 0.111 | 0.087 | 0.098 |
| Unbleached kraft—unbeaten | 0.107 | 0.123 | 0.102 |
| 50:50 bleached kraft-soda | | 0.105 | 0.113 |

* 63 pounds basis weight. ** 131 pounds basis weight.

In Fig. 7 is shown the relationship between water removal and time for sheets of bleached kraft having a basis weight of 180 pounds, 25 × 40—500. Curves 1, 2, and 3 show the observations at 265, 240, and 205°F., respectively, with the stock from which the sheets were formed having a freeness of 630 ml. Schopper-Riegler. Curve 4 (dotted) shows the relationship for paper of the same weight made from bleached kraft treated in the Bauer disk refiner to a freeness of 380 ml. Schopper-Riegler.

These curves are fairly typical of the results observed where a second critical point was not apparent.

Figure 8 presents the observed results obtained on bleached kraft sheets of 90-pound basis weight but unbeaten. Even though these sheets should be free from cockle a second critical point seems apparent for the sheet dried at 240° and 150°F.

## Summary of the Experimental Results

1. When the experimental data from the special apparatus were plotted as "water removed" versus "time of drying," the curves (Fig. 7), were characterized by (*a*) a constant rate period when the sheet was wet, as indicated by a straight line on the drying curves (this straight line passed through the origin); (*b*) a critical moisture content at which the first constant rate ceases; and (*c*) a second constant rate, lower than the first one, when the moisture content is less than the critical moisture content.

2. The rate of drying during the constant rate period increased continuously with the drier temperature for the temperature range studied (160° to 280°F.). The relation was approximately linear.

3. The effect of temperature on the critical moisture content was uncertain. The critical moisture content was at a minimum at a drier temperature of 205°F. for the 45- and 90-pound beaten sheets, but with the 180-pound sheet the lowest critical moisture content was at 270°F.

4. The effect of temperature on the rate of drying during the second constant rate period was uncertain. The trend was for increased rates with higher temperatures, but the data for the 45-pound beaten sheet at 190°F., are contrary to this trend.

5. The over-all rate of drying increased with increasing temperature, although the 45-pound beaten sheet at 190°F. was again out of line.

TABLE VII.—EQUATIONS EXPRESSING THE DRYING RATE AS A FUNCTION OF THE DRIER TEMPERATURE

The expressions give the experimental drying rates as pounds of water per hour per square foot of sheet. Temperatures are represented by "*t*."

| Bleached Kraft | First Constant Rate | Over-all Rate |
|---|---|---|
| Unbeaten — 90-lb. | $0.0254\,t - 3.01$ | $0.0193\,t - 2.63$ |
| 180-lb. | $0.0166\,t - 1.78$ | $0.0110\,t - 1.05$ |
| Beaten to 630 ml. S.R. | | |
| 90-lb. | $0.0219\,t - 2.41$ | $0.0166\,t - 2.21$ |
| 180-lb. | $0.0194\,t - 2.49$ | $0.0079\,t - 0.65$ |

The slopes of these curves indicate the actual increase in the rate of drying with increase in temperature. The fact that this increase is greater for the constant rate period—i.e., at the wet end of the machine—than for the over-all rate may be of interest. However, on the basis of the percentage increase in rate between drier temperatures of 230° and 240°F., the over-all rate increased more with increased temperature than did the first constant rate in the case of the 90-pound sheets, whereas the reverse was true in the case of the 180-pound sheets.

6. With heavier sheets, the critical moisture content was generally higher, the first constant rate was always lower, the second constant rate was higher in some cases, and the over-all rate was lower.

7. With greater hydration, the critical moisture content was higher in all cases with the 240°F. surface. The first constant rate was greatest with the unbeaten sheet, but there was not much difference between the

Bauer-milled pulp and that beaten to 630 ml. S.R. with a 240° F. surface. The Bauer-milled pulp definitely dried slower with the 205°F. surface. There was no clear trend for the effect of hydration on the second constant rate. At 240°F. the unbeaten sheets had lower rates and at 205°F., higher rates. The over-all rates were lower with the more beaten sheets.

8. Comparing 90-pound sheets with different furnishes at 630 ml. S.R. and 240°F. drier temperature, the following ranks prevailed in order of descending magnitude:

| Critical Moisture Content | First Constant Rate |
|---|---|
| 50-50 soda-bleached kraft | 50-50 soda-bleached kraft |
| 75-25 groundwood-unbleached sulphite | Bleached kraft |
| Bleached kraft | Unbleached sulphite |
| Unbleached sulphite | 75-25 groundwood-unbleached sulphite |
| **Second Constant Rate** | **Over-all Rate** |
| 50-50 soda-bleached kraft | Bleached kraft |
| 75-25 groundwood-unbleached sulphite | 75-25 groundwood-unbleached sulphite |
| Bleached kraft | 50-50 soda-bleached kraft |
| Unbleached sulphite | Unbleached sulphite |

Comparing unbeaten bleached kraft and unbeaten unbleached kraft, the bleached kraft had a higher critical moisture content and a lower second constant rate with no significant difference in the first constant rate or in the over-all rate of drying. Effects from the addition of clay were not detected but the percentage of clay retained was so small that the experiment was not conclusive.

9. When the sheet was dried with continuous contact of the sheet with one drier surface, the rate of drying was somewhat less than when the ordinary procedure was used.

10. The following differences were found between the results with oven drying and those with the special apparatus:

(a) The effect of basis weight on critical moisture was reversed.

(b) With oven drying there was a great difference between the Bauer-milled pulp and the others. There were only slight differences with the special apparatus.

(c) With the special apparatus there were great differences between the unbeaten pulps and the others. There were only slight differences with oven drying.

(d) The lighter sheets definitely dried faster with the special apparatus. This trend was not observed with oven drying.

## Discussion of Observations

In order to explain the experimental results, a new concept of the mechanism of paper machine drying seems necessary. Development of such a conception must account for the following phenomena:

1. A constant rate of drying occurred from the time the wet sheet entered the drier until a "critical moisture content" was reached. At this "critical moisure content," a sharp decrease in drying rate occurred, followed by an apparently constant rate of drying which persisted until the sheet was almost dry.

2. The "critical moisture contents" were lower with the lighter sheets and with the more porous sheets. In some cases, the "critical moisture content" was less than the fiber saturation point.

3. The rate of drying increased continuously with drier temperatures for the temperature range studied (160° to 280°F.). The relation was approximately linear, although there was some evidence that the curve for the 180-pound beaten sheet was leveling off at the higher temperatures.

4. With the heavier sheets the drying rates were lower and the critical moisture contents were higher.

5. With greater mechanical hydration, the drying rates were lower and the critical moisture contents were higher.

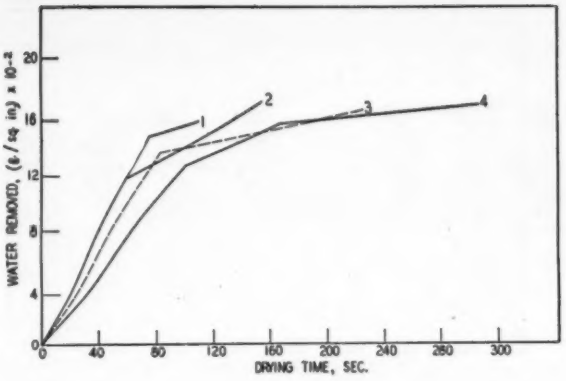


FIG. 7

**Bleached Kraft, Beaten to 630 ml. S.R., 180-lb. Basis Weight—1. 265° F. Drier Temperature; 2. 240° F. Drier Temperature; 3. 240° F. Drier Temperature (Bauer Mill, 380 ml. S.R.); 4. 205° F. Drier Temperature**

6. Differences between different pulps were not marked. Porosity appeared to be more of a factor in drying than bulkiness.

7. When the sheet was dried with continuous contact of the sheet with one drier surface, the rate of drying was somewhat less than when the ordinary procedure was used.

8. The following differences were found between the results obtained with oven drying and the results with the special apparatus:

(a) The effect of basis weight on critical moisture content was reversed.

(b) With oven drying there was a great difference between the Bauer-milled pulp and the others. There were only slight differences with the special apparatus.

(c) With the special apparatus there were great differences between the unbeaten pulps and the others. There were only slight differences with oven drying.

(d) The lighter sheets definitely dried faster with the special apparatus. This was not observed with oven drying.

Figure 9 will serve to assist in the development of a satisfactory concept.

GLOSSARY OF THE SYMBOLS USED IN FIGURE 9 AND IN THE DISCUSSION

| Symbol | Definition |
|---|---|
| A | Hypothetical zone of vapor or air saturated with vapor |
| B | Hypothetical zone of dry fiber |
| C | Zone of free water |
| D | Hypothetical zone of dry fiber |
| E | Air film in the usual engineering sense |
| *x-a* | Thickness of zone A |
| *x-b* | Thickness of zone B |
| *x-c* | Thickness of zone C |
| *x-d* | Thickness of zone D |
| *x-e* | Thickness of zone E |
| *t'* | Temperature at the drier surface |
| *t-a* | Temperature of the inner surface of the sheet |
| *t-b* | Temperature of the inner boundary of the free water zone |
| *t-c* | Temperature of the outer boundary of the free water zone |
| *t-d* | Temperature of the outer surface of the sheet |

(1) A vapor film (zone A) is formed between the sheet and the drier unless the sheet is pressed, when wet, against the hot drier, as in Yankee driers.

(2) Layers are formed on both sides of the sheet (zones B and D), in which the moisture content is below the fiber saturation point.

(3) A dynamic equilibrium is established in the sheet almost instantaneously. The interface between zones C and D is thus established at the point (idealized) where the rate of evaporation equals the combined rate of liquid diffusion and condensation.

If the simple equations for the rate of transfer of heat and of vapor are kept in mind, it is evident that the rate of drying is intimately connected with the temperature *t-c*. Thus the driving force in the trans-

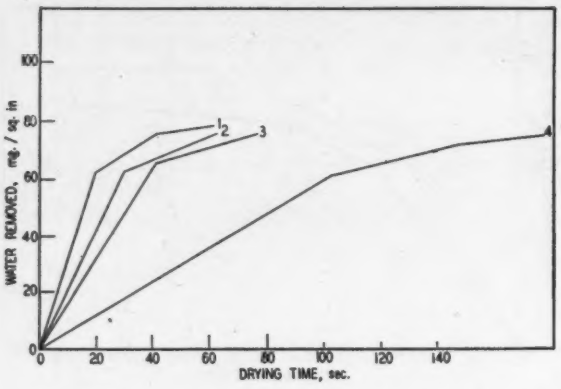


FIG. 8

**Bleached Kraft, Unbeaten. Drier Temperature: 1. 240° F.; 2. 225° F.; 3. 200° F.; 4. 150° F.**

fer of heat to the interface C-D is the temperature difference $t'$ minus $t$-$c$, and the driving force in the transfer of vapor from that interface is the pressure difference $p$-$c$ minus $p$-$e$ where $p$-$c$ is the vapor pressure associated with the temperature $t$-$c$ and $p$-$e$ is the partial pressure of water vapor in the atmosphere.

The constant rate maintained in the first period of drying can be understood as the result of the equilibrium between heat transfer to the interface *C-D* and vapor transfer from that interface. This equilibrium corresponds to a constant rate of drying because as the interface recedes into the sheet and towards the drier surface, the increasing resistance to vapor diffusion which results is counteracted by the increasing $t$-$c$ due to the decreased thermal resistance between the drier surface and the interface.

The data indicate that this constant rate is maintained, under some conditions, to the point where the moisture content in the interior of the sheet reaches the fiber saturation point. The over-all moisture content at this point, in other words the critical moisture content, then depends on the gradient of moisture content in the "dry" zones to some extent.

Paper stocks which show a second break and a second reduction in the rate of drying are those which dry to a sheet of considerable stiffness with a slight tendency to cockle. The rate of heat transfer through zone A is thereby retarded by the considerable increase in the thickness of the vapor and air space through which it must pass.

The sharp change in rate at the critical moisture content indicates that some part of the mechanism of constant rate drying is rendered impossible within a narrow range of moisture contents. The factor involved is likely to be the ability of liquid water to diffuse within the sheet.

It was shown by the experimental results that the differences between different stocks found in oven drying were often not found in the data obtained with the special apparatus, and vice versa. Furthermore, the experimental results show that drying curves from oven drying data and from the data of the special apparatus are not exactly the same form. The difference is that, after the first critical moisture content, the rates of drying calculated from the oven drying data decreased continuously and gradually, whereas the rates of drying from the data obtained with the special apparatus decreased sharply at the critical moisture content and then became constant.

The reason for these discrepancies becomes apparent when the mechanism of oven drying is recalled.

Sherwood *(1, 2, 3)* has explained the constant rate period, the first falling rate period, and the second falling rate period as follows: During the constant rate period evaporation takes place at the surface of the sheet, and diffusion of water to the surface is rapid enough to keep the surface wet although, in general, the free water concentration at the surface is constantly decreasing. During the first falling rate period, in which the rate decreases linearly with the moisture content, evaporation still takes place mostly at the surface of the sheet, but the area in which free water exists is decreasing. When free water no longer exists at the surface, the rate of drying falls sharply as the zone of evaporation moves into the interior of the sheet. The reason for evaporation from a partially wetted surface during the first falling rate period is that the large pores on the surface will dry out before the small ones.

It is obvious that the mechanism of oven drying is considerably different from that deduced for machine drying. The relative effect of some or all of the factors will be different for the different mechanisms.

However, there is one factor definitely involved in both types of drying, albeit not at the same period of each process. This is the rate of diffusion of liquid water to the zone of evaporation. (As pointed out by Ceaglske and Hougen *(4)*, this process is not diffusion in the strict sense because the driving force is capillarity rather than a concentration gradient.) In the proposed mechanism for machine drying, liquid diffusion is important in establishing the first constant rate of drying because the interface of the zones C and D of Fig. 9 is established at the plane where free water is supplied at a rate equal to the rate of evaporation from that plane. In the generally accepted mechanism for oven drying, the first constant rate is determined solely by the resistance to diffusion of the outer air film. However, the rate of liquid diffusion would determine the moisture contents at which surface evaporation ceases—i.e., the critical moisture contents.

It would be of interest to calculate an index of diffusion or capillarity from the oven drying curves. Such an index would involve not only the critical moisture contents, but also the rates of drying during the first falling rate period. This is deduced from the fact that, for the same second critical moisture content, the capillarity would be higher in the sheet in which the given moisture content corresponded to a higher rate. It was not possible to establish the proper relations of these factors in a satisfactory index of capillarity. This may be possible with additional data. However, it should be stressed that both the porosity, and the capillarity, determine the rate of machine drying.

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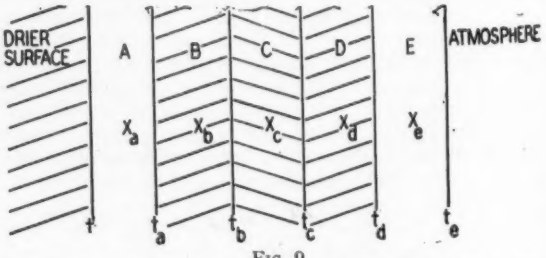


FIG. 9

**Schematic Sketch of a Sheet of Wet Paper in Contact with a Drier**

Unusually powerful moisture attraction by

# CORPOLIN

It is a heavy, clear, colorless and odorless liquid; free-flowing; non-volatile; non-poisonous; imparts non-inflammability to paper; compatible with other plasticizers. Corpolin is widely used in the Paper Industry as a plasticizer for many purposes.

*Promptly available in tons and carloads. Samples upon request.*

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**The answer to your wood peeling problem**

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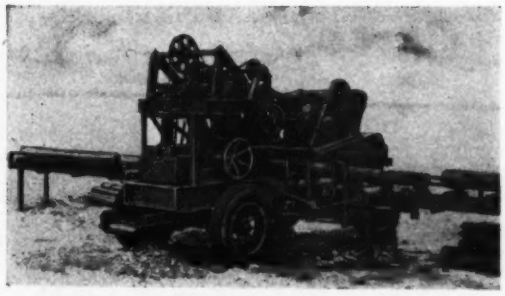

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### *You Are Sure*

**In these days of labor shortages it has been impossible for many mills to obtain enough peeled wood. Because of the increased production per man the Nekoosa Portable Wood Peeler has made it possible for many mills to obtain peeled wood, which otherwise would have had to handle it rough.**

**Thus this machine helps assure you of a supply of peeled wood, even though there is a shortage of woods labor.**

**Large Capacity**

**Low Cost Operation**

**No Wood Loss**

## Nekoosa Foundry & Machine Works Inc.

Nekoosa, Wis. U. S. A.

# New York Paper and Pulp Market Review

## Over-All Paper Supply Continues Tight In Book and Newsprint—Canada Expects More Newsprint For U. S. In 1946 — Norway Regards OPA Pulp Prices Too Low—Paper Stock Buying Steady.

Office of the PAPER TRADE JOURNAL,
Wednesday, March 6, 1946.

The over-all paper supply is currently tight, with book paper and newsprint most scarce. Extremely heavy demand for book paper, especially for publication paper at this date, is expected to continue for months, with an increasing demand for coated book paper, as catalogue and direct mail literature plans are developed. Despite the present inadequate labor supply to harvest pulpwood, Canada expects more newsprint will be available for United States publishers this year.

The current tight situation in wood pulp is expected to continue through at least the second half of this year. In addition to paper making requirements, demands of the rayon industry are currently reported as very large and that industry does not forsee an adequate supply of the rayon grades of wood pulp to meet present production schedules.

More paper will be available this year in standard weights and while the high production ratio of over 95% of six-day capacity may be expected to be continued, low inventories and increased trade consumption will indicate an apparent scarcity for most of this year. But, while users may not be satisfied they are obtaining all the paper they want, enough paper will be manufactured to provide a reasonably large supply for actual needs, if not for speculative purchasing.

The index of general business activity for the week ended February 23 rose to 118.3, from 110.8 in the previous week, compared with 146.2 in the corresponding week in 1945. The index of paperboard production was 156.0, compared with 149.8 in the previous week, and with 153.4 in the corresponding week in 1945.

Paper production for the week ended February 23 was estimated at 98.0%, compared with 89.7% in 1944, with 98.0% in 1943, and with 103.5% for the corresponding week in 1942.

Paperboard production for the week ended February 23 was 93.0%, compared with 97.0% in 1945, with 93.0% in 1944, with 94.0% in 1943, and with 100.0% for the corresponding week in 1942.

### Wood Pulp

The present unsatisfactory wood pulp price schedules of OPA are reflected in the decision of one of the largest pulp producers in Norway, which has declined selling pulp to the U. S. as it considers OPA prices are below production costs in Norway. If the price was increased to $8 a ton above the present OPA price of $86 a ton, it would be $94 a ton, f.o.b. consumer's mill. In the case of exports from Norway, the producer would have to deduct inland freight in America, ocean freight, commission and insurance and would then get a net f.o.b. figure of about $86 a long ton (2240 lbs.), which is not acceptable to this Norwegian producer. The same mill recently stated that it is selling "Super VS" rayon pulp for $130 a ton, f.o.b. Sarpsborg, and can obtain $120 a long ton for bleached sulphite on European and overseas markets. For second grade bleached paper sulphite, the same mill is receiving about $120 per 1000 kilos, f.o.b. Sarpsborg, net cash against documents.

### Rags

The market for new cotton cuttings is reported strong this week. Supplies are under the heavy demand and no encouraging reports are received indicating larger supplies of cotton goods are available to the garment trades. Prices are strong at ceiling levels.

Demand in the old cotton rag market is strong, with current reports indicating short supplies. The most insistent call continues to be in the roofing grades. The tremendous pent-up demand for building demands heavy capacity production of roofing felt mills for months to come. Prices are strong in old whites, blues and thirds, at ceiling levels.

### Bagging

Current reports indicate prices are very firm in old bagging. Demand is reported as fair. The firm price situation is quite widely interpreted to mean that limited supplies is naturally maintaining a firm price situation through the operation of the law of supply and demand.

### Waste Paper

Demand for waste paper continues steady. Improvement in the inventory position of mills is reported continuing, but most mills are still in the market for large tonnages of the bulky grades. Prices are firm at ceiling levels.

## Specialty Paper and Board Affiliates

The Specialty Paper and Board Affiliates held their annual meeting at the Waldorf-Astoria Hotel on January 16 and 17.

Walter B. Sheehan, president of the Missisquoi Corporation, Sheldon Springs, Vt., and Jack B. Cowie, Hollingsworth & Whitney Co., was named as vice president, with G. D. Cook continuing as secretary-treasurer.

The only change in the executive committee was the election of Walter A. Lowe, Falulah Paper Co. to succeed W. S. Gamble, Brownville Board Co. The other members are: S. B. Sutphin, Beveridge Paper Co.; H. S. Lewis, J. P. Lewis Co.; P. R. Bachman, Riegel Paper Corporation; Kendall Wyman, Champion Paper and Fibre Co.; S. Stewart Foster, Foster Paper Co., Inc.; G. E. O'Connor, Mohawk Paper Mills, Inc.; Frank C. Ash, Oswego Falls Corporation; H. C. Johnson, The Sorg Paper Co.; A. K. Nicholson, Hollingsworth & Vose Co.; Malcolm B. Lowe, Lowe Paper Co.; Maurice A. Park, the Marvellum Co.; F. Henry Savage, International Paper Co.; J. N. Logan, Newton Paper Co.; Mr. Sheehan and Mr. Cowie.

Sell your Paper through the Paper Merchants and

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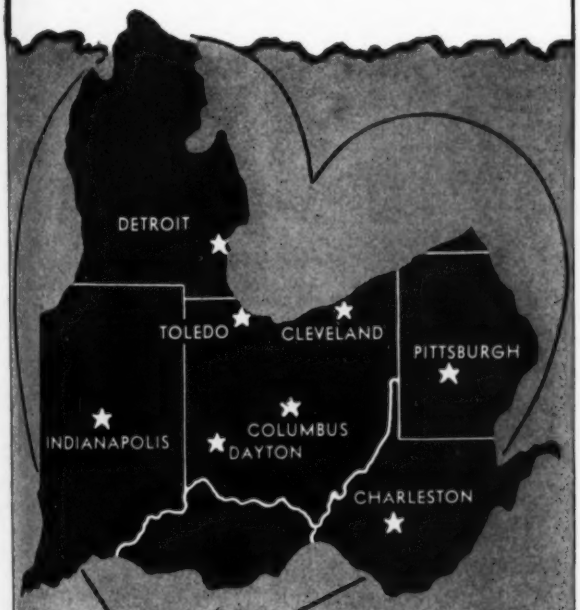


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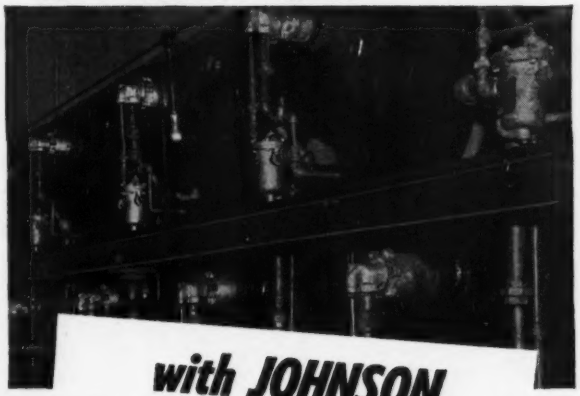
STRETCH MAN HOURS



with JOHNSON Rotary Pressure Joints

WHEN you're looking for ways to ease today's "Help Wanted" problem, it will pay to check into your stuffing boxes or steam fits. They demand a lot of care and attention—for inspecting, servicing and, too frequently, for replacing parts worn rapidly by misalignment.

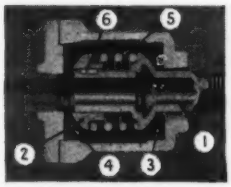
With Johnson Rotary Pressure Joints you save these precious hours of labor for more productive work, because the Johnson Joint is completely packless, self-oiling, self-adjusting and even self-aligning. You save also the production time that is wasted when machines are shut down for stuffing box repair. And with the Johnson Joint you have a simpler, easier way to provide modern, more efficient methods of syphon roll drainage.

For today's big task these production boosting benefits of the Johnson Joint are of first importance. Don't overlook, however, the savings in dollars and cents—in reduced maintenance and longer life—which can quickly pay the cost of change-over. Make that your final reason for joining the hundreds of Johnson Joint users.

TODAY'S WAY TO SAVE TIME AND TROUBLE

● Nipple (1) fastened to roll. Sliding collar (2) keyed to nipple. Carbon graphite seal ring (3) and bearing ring (4) which eliminate oiling and packing. Spring (5) is for initial seating only; joint is actually pressure sealed when in operation.

*Write for full information*

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Today's highest development in a trap for pumping or lifting service, and for draining vacuum lines under vacuum as complete as 27" of mercury. Electric control makes operation as dependable as flow of electricity; there are no floats or stuffing boxes—no moving parts of any kind on trap chamber. Control valve gear is one compact assembly—can be mounted in any convenient location if trap chamber must be set in inaccessible position. Ask for bulletin.

The Johnson Corporation
828 WOOD STREET THREE RIVERS, MICH.

# MISCELLANEOUS MARKETS

Office of the PAPER TRADE JOURNAL,
Wednesday, March 6, 1946.

BLANC FIXE — Prices on blanc fixe continue unchanged at prevailing levels. Demand is reported good. The pulp is quoted at $40 per ton, in barrels, at works. The powder is quoted at $60 per ton, f.o.b. works.

BLEACHING POWDER — All-over demand continues heavy. Production high. Quotations are unchanged. Bleaching powder is currently quoted at from $2.50 to $3.10 per 100 pounds. All prices in drums, car lots, f.o.b. works.

CASEIN—Supply under heavy demand. OPA maximum prices on processed acid-precipitated casein are as follows: 10,000 pounds or more, 24 cents per pound; 2,000 pounds, 24½ cents per pound; less than 2,000 pounds, 24¾ cents per pound f.o.b. shipping point. Imported 24 cents.

CAUSTIC SODA—Demand heavy Production large, but under demand. Dry forms reported still in short supply. Solid caustic soda is currently quoted at $2.30 per 100 pounds. The flake and ground are currently quoted at $2.70 per 100 pounds. All prices in drums, car lots, f.o.b. works.

CHINA CLAY—Current demand is reported heavy on many grades of china clay. Quotations unchanged. Domestic filler clay is quoted at from $7.50 to $15 per ton; coating clay is quoted at from $12 to $22 per ton, at mines. Imported china clay is currently quoted at from $13 to $25 per long ton, ship side.

CHLORINE—Demand heavy with output increasing. Outlook now favorable, but short supply of tank cars and cylinders slows shipments. Chlorine is currently quoted at $1.75 per 100 pounds, in single unit tank cars, f.o.b. works.

ROSIN — No offerings or sales. The OPA price on "G" gum rosin is $6.74 per 100 pounds in barrels, at Savannah. "FF" rosin is established quoted at $6.70 per 100 pounds, in barrels at New York. Average price on seventy per cent gum rosin size is $6.95 per 100 pounds, f.o.b. works.

SALT CAKE—Prices on salt cake continue to be reported unchanged. Domestic salt cake is currently quoted at $15 per ton, in bulk. Chrome cake is currently quoted at $16 per ton. All quoted prices in car lots, f.o.b. shipping point.

SODA ASH—Demand for soda ash is reported heavy. Packaged shipments still slow. Market tight. Prices continue to conform to prevailing levels. Quotations on soda ash in car lots, per 100 pounds, are as follows: in bulk, $.90; in paper bags, $1.05; and in barrels, $1.35.

STARCH—Corn market is reported steady. Shipments fair this week. Demand heavy. Prices unchanged on starch. Pearl is quoted at $3.72 per 100 pounds. Powdered starch is quoted at $3.83 per 100 pounds. All prices in bags, car lots, f.o.b. Chicago.

SULPHATE OF ALUMINA—Demand good. Short temporary supply improving. Prices of the commercial grades are currently quoted at from $1.15 to $1.25 per 100 pounds. The iron free is currently quoted at $1.75 per 100 pounds. All prices in bags, car lots, f.o.b. works.

SULPHUR — Current consumption of sulphur continues heavy. Market situation unchanged. The quotation on annual contracts continues at $16 per long ton, f.o.b. mines. The current price on contracts at Gulf Ports is $17.50 per long ton.

TALC—Demand reported good. Domestic grades are currently quoted at from $16 to $21 per ton at mines. Canadian at $24 per ton. All prices in car lots.

# MARKET QUOTATIONS

All market quotations, excepting those otherwise designated as official OPA maximum prices, are based on the manufacturers' price level as of October 1-15, 1941; maximum wholesale prices are based on the merchants' maximum prices for stipulated quantities at a quoted price to all customers of a like class, as shown by the merchant's sales records of goods delivered during March, 1942. A merchant's price list in effect in March 1942, showing quotations of actual shipments, will establish the current maximum prices.

## Paper

(Delivered New York)

| | | | |
|---|---|---|---|
| Standard News, per ton— | | | |
| Roll, contract | *$61.00 | @ | — |
| Sheets | 69.00 | @ | — |
| * OPA Maximum Price. | | | |
| Kraft—per cwt.—Carload Quantities Zone A, Delivered | | | |
| Superstandard Wrapping | *$5.25 | @ | — |
| No. 1 Wrapping | *5.00 | " | — |
| Standard Wrapping | *4.75 | " | — |
| Standard Bag | *4.375 | " | — |
| * OPA Manufacturers' Prices. | | | |
| Tissues—Per Ream—Carlots | | | |
| White No. 1 | 1.12½ | " | — |
| White No. 1 M. G. | 1.10 | " | — |
| White No. 1½ | 1.00 | " | — |
| White No. 2 | .90 | " | — |
| Anti-Tarnish M.F. | 1.20 | " | — |
| Colored | — | " | — |
| Kraft | .95 | " | — |
| Manila | .90 | " | — |
| Toilet—1 M. Sheets—Per Case | | | |
| Unbleached | 4.25 | " | — |
| Bleached | 5.70 | " | — |
| Unbl. Toilet, 1 M. | 4.16 | " | — |
| Bleached Toilet | 5.70 | " | — |
| Paper Towels, Per Case— | | | |
| Unbleached, Jr. | 2.20 | " | — |
| Bleached, Jr. | 3.20 | " | — |
| Manila—per cwt.—C. l. f. a. | | | |
| No. 1 Jute | 11.25 | @ | — |
| No. 1 Manila Wrapping, 35 lb. | 6.00 | " | 6.25 |
| No. 2 Manila Wrapping, 35 lb. | 5.75 | " | 6.00 |
| Boards, per ton— | | | |
| News | *54.00 | @ | — |
| Chip | *54.00 | @ | — |
| Sgl. Mla. L1. Chip | *65.00 | @ | — |
| White Pat. Coated | *79.00 | @ | — |
| Kraft Liners 50 lb. | *63.00 | " | — |
| Binders Boards | 84.00 | " | 116.00 |

* OPA Base Prices per 10 tons. Less than 10 tons but over 3 tons, add $2.50; three tons or less, add $5; regular 35-39 basis, add $5; basis 40-49, add $2.50; basis 91-100, add $2.50; basis 101-120, add $5.

The following are representative of distributors' resale prices:

Rag Content Bonds and Ledgers—White, Assorted Items
Delivered in Zone 1:

| | Bonds | Ledgers |
|---|---|---|
| 100% Rag Ext. No. 1 | $39.10@$46.00 | $40.25@$47.25 |
| 100% Rag | 32.20 " 37.75 | 33.35 " 39.25 |
| 85% Rag | .... " .... | 29.90 " 35.00 |
| 75% Rag | 23.00 " 27.00 | 24.15 " 28.25 |
| 65% Rag | .... " .... | 22.80 " 27.75 |
| 50% Rag | 18.70 " 22.75 | 19.90 " 24.25 |
| 25% Rag | 16.40 " 20.00 | 17.55 " 21.50 |

Colors at $1.00 cwt. extra.

Sulphite Bonds and Ledgers—White, Assorted Items
Delivered in Zone 1:

| | Bonds | Ledgers |
|---|---|---|
| No. 1 | $10.55@$12.75 | $11.70@$14.25 |
| No. 2 | 9.65 " 11.75 | 10.80 " 13.25 |
| No. 3 | 9.20 " 11.25 | 10.35 " 12.50 |
| No. 4 | 8.90 " 10.75 | 10.05 " 12.25 |

Colors $1.00 cwt. extra.

Free Sheet Book Papers—White, Cased Paper
Delivered in Zone 1:

| | | | |
|---|---|---|---|
| No. 1 Glossy Coated | $13.65 | @ | $15.50 |
| No. 2 Glossy Coated | 12.40 | " | 14.00 |
| No. 3 Glossy Coated | 11.60 | " | 13.25 |
| No. 4 Glossy Coated | 11.15 | " | 12.75 |
| No. 1 Antique (watermarked) | 10.25 | " | 11.75 |
| No. 2 Offset | 9.60 | " | 11.00 |
| A Grade E. F. | 9.35 | " | 10.75 |
| A Grade S. & S. C. | 9.60 | " | 11.00 |
| B Grade E. F. | 8.85 | " | 10.25 |
| B Grade S. C. | 9.10 | " | 10.50 |
| C Grade E. F. | 8.55 | " | 9.75 |
| C Grade S. C. | 8.80 | " | 10.00 |
| D Grade E. F. | 8.25 | " | 9.50 |
| D Grade S. & S. C. | 8.50 | " | 9.75 |

Ivory & India at $.50 cwt. extra.

## Wood Pulp

OPA Maximum Prices and Canadian Manufacturers' Prices, Less Freight.
Not Exceeding OPA Allowances.

| | | | |
|---|---|---|---|
| Bl. Softwood Sulphite | $86.00 | | |
| Unbl. Softwood Sulphiite | 74.00 | | |
| Bl. Hardwood Sulphite | 83.50 | | |
| Unbl. Hardwood Sulphite | 71.50 | | |
| Bl. Mitscherlich | 81.00 | | |
| Unbl. Mitscherlich | 72.00 | @ | 82.00 |
| N. Bleached Sulphate | 86.00 | | |
| S. Bleached Sulphate | 79.00 | | |
| N. Semi-Bleached Sulphate | 82.00 | | |
| S. Semi-Bleached Sulphate | 75.00 | | |
| N. Unbl. Sulphate | 73.00 | | |
| S. Unbl. Sulphate | 63.50 | | |
| Bl. Soda | 76.00 | | |
| Unbl. Soda | 72.00 | | |
| Groundwood | 50.00 | | |

Transportation Allowances

Applying to Producers of Wet Wood Pulp.

| | Below 50% Air Dry Weight |
|---|---|
| Northeast | $13.50 |
| Lake Central | 13.50 |
| Southern | 16.00 |
| West Coast (in area) | 10.50 |
| West Coast (out area) | 16.50 |

| | 50%-80% Air Dry Weight |
|---|---|
| Northeast | $11.50 |
| Lake Central | 11.50 |
| Southern | 14.00 |
| West Coast (in area) | 9.50 |
| West Coast (out area) | 15.50 |

Applying to Producers of Dry Wood Pulp.

| | Above 80% Air Dry Weight |
|---|---|
| Northeast | $8.50 |
| Lake Central | 8.50 |
| Southern | 11.00 |
| West Coast (in area) | 7.50 |
| West Coast (out area) | 13.50 |

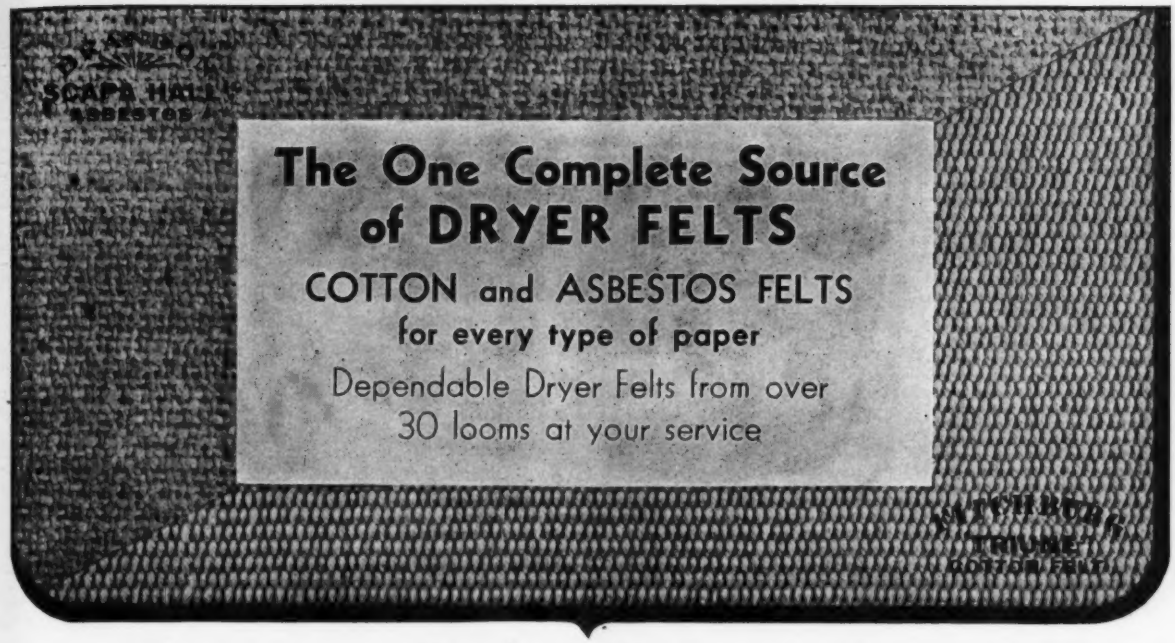
Should freight charges actually exceed these allowances, the difference may be added to the maximum prices.

## Domestic Rags

New Rags
(Prices to Mill f. o. b. N. Y.)

| | | | |
|---|---|---|---|
| Shirt Cuttings— | | | |
| New White, No. 1 | 6.50 | @ | 7.25* |
| Silesias No. 1 | — | " | 5.75* |
| New Unbleached | 6.75 | " | 7.50* |
| Blue Overall | — | " | 5.50* |
| Fancy | — | " | 3.50* |
| Washables | — | " | 3.00* |
| Bleached Khaki Cuttings | — | " | 4.25* |
| Unbleached Khaki Cuttings | — | " | 3.50* |

* OPA Maximum Prices.

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**Morey Paper Mill Supply Co.**

309 SOUTH ST., FITCHBURG, MASSACHUSETTS

FITCHBURG DUCK MILLS ESTABLISHED 1844. DRYER FELTS

Sole Distributors for

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**You Paper Mill Men • *take a Tip on Kalamazoo Tile Stock Tanks and Chests • you can't beat them for* STRENGTH *and* DURABILITY •**

**Kalamazoo Vitrified Glazed Tile** *is a "Natural" for Paper Mill Needs—*

**Smooth, hard, strong, easily cleaned and highly resistant to chemical action, this marvelous vitrified glazed tile type of construction is preferred by scores of leading paper mill executives and engineers. Adaptable for stock tanks and chests of all kinds. Costs no more than concrete tanks that require constant maintenance expense.**

**An exclusive method of glazed tile tank construction developed by Kalamazoo engineers. It provides greater flexibility and lower cost for all paper mill stock handling problems. Immediately available.**

**● Any Size or Shape Desired—**

**Wide, narrow—shallow or deep. Round, rectangular or square. Half-round or tapered bottom and corners. Mid-feathers and fins where needed to control stock flow. Adaptable to pumps or agitators. Construction individually designed to meet space, tonnage or production requirements.**

**Ask for engineering data.**

Kalamazoo TANK & SILO CO. KALAMAZOO • MICHIGAN

### Old Rags

| | | | |
|---|---|---|---|
| White, No. 1— | | | |
| Repacked | *3.80 | @ | — |
| Miscellaneous | *3.20 | " | — |
| White, No. 2— | | | |
| Repacked | *2.90 | " | — |
| Miscellaneous | *2.65 | " | — |
| Thirds and Blues— | | | |
| Repacked | *2.20 | " | — |
| Miscellaneous | *1.30 | " | — |
| Roofing Rags— | | | |
| No. 1 | *1.55 | " | — |
| No. 2 | *1.45 | " | — |
| No. 3 (bagging) | *1.35 | " | — |
| No. 4 | *1.35 | " | — |
| No. 5A | *1.35 | " | — |
| Old Manila Rope | 5.75 | " | — |

* OPA Maximum Prices.

## Foreign Rags

Pre-War Quotations

All Prices Nominal

### New Rags

| | | | |
|---|---|---|---|
| New Dark Cuttings | 2.25 | @ | 2.40 |
| New Mixed Cuttings | 2.00 | " | 2.20 |
| New Light Silesias | 5.50 | " | 5.75 |
| Light Flannelettes | 5.50 | " | 5.75 |
| New White Cuttings | 7.00 | " | 7.50 |
| New Light Oxfords | 4.00 | " | 4.50 |
| New Light Prints | 3.00 | " | 3.25 |

### Old Rags

| | | | |
|---|---|---|---|
| No. 1 White Linens | 7.50 | " | 8.50 |
| No. 2 White Linens | 6.50 | " | 7.50 |
| No. 3 White Linens | 4.50 | " | — |
| No. 4 White Linens | 2.25 | " | 3.25 |
| No. 1 White Cotton | 4.25 | " | 4.75 |
| No. 2 White Cotton | 3.25 | " | 3.75 |
| No. 3 White Cotton | 2.50 | " | 3.00 |
| No. 4 White Cotton | 1.90 | " | 2.20 |
| Extra Light Prints | 2.00 | " | 2.40 |
| Ord. Light Prints | 1.75 | " | 2.15 |
| Med. Light Prints | 1.55 | " | 1.95 |
| Dutch Blue Cottons | 2.25 | " | 2.50 |
| French Blue Linens | 3.00 | " | — |
| Checks and Blues | 2.00 | " | — |
| Linsey Garments | 1.90 | " | 2.00 |
| Dark Cottons | 1.50 | " | 1.60 |
| Old Shopperies | 1.30 | " | 1.45 |
| New Shopperies | 1.45 | " | 1.50 |
| French Blues | 2.25 | " | 2.50 |

## BAGGING

(Prices to Mill, f. o. b. N. Y.)

| | | | |
|---|---|---|---|
| Gunny No. 1— | | | |
| Foreign | Nominal | | |
| Domestic | 3.25 | @ | 3.30 |
| Wool Tares, light | 3.25 | " | 3.50 |
| Wool Tares, heavy | 3.50 | " | 3.75 |
| Bright Bagging | 3.25 | " | 3.50 |
| Manila Rope— | | | |
| Foreign | — | " | — |
| Domestic | *5.75 | " | — |
| Jute Threads | 5.50 | " | — |
| No. 1 Sisal Strings | *4.00 | " | — |
| Mixed Strings | 1.50 | " | — |

* OPA Maximum Prices.

## Old Waste Papers

(F. o. b. New York)

OPA Maximum Prices, Baled

| | | | |
|---|---|---|---|
| No. 1 Hard White Envelope Cuts, one cut | 3.37½ | @ | — |
| No. 1 Hard White Envelope Cuts | 3.12½ | " | — |
| No. 1 Hard White Shavings, unruled | 2.87½ | " | — |
| No. 1 Hard White Shavings, ruled | 2.50 | " | — |
| Soft White Shavings, one cut | 2.87½ | " | — |
| No. 1 Soft White Shavings | 2.50 | " | — |
| Soft White Shavings, Misc. | 2.15 | " | — |
| No. 1 Fly Leaf Shavings | 1.67½ | " | — |
| No. 2 Fly Leaf Shavings | 1.12½ | " | — |
| No. 1 Groundwood Fly Leaf Shavings | 1.25 | " | — |
| No. 2 Mixed Groundwood Fly Leaf Shavings | .90 | " | — |
| Mixed Colored Shavings | .75 | " | — |
| Mixed Groundwood Colored Shavings | .90 | " | — |
| Overissue Magazines | 1.67½ | " | — |
| No. 1 Heavy Books & Magazines | 1.92½ | " | — |
| Mixed Books | 1.10 | " | — |
| No. 1 White Ledger | 2.30 | " | — |
| No. 2 Mixed Ledger, colored | 2.00 | " | — |
| New Manila Envelope Cuttings, one cut | 2.87½ | " | — |
| New Manila Envelope Cuttings | 2.65 | " | — |
| Extra Manilas | 1.95 | " | — |
| Mixed Kraft, Env. & Bag Cuttings | 2.75 | " | — |
| Kraft Envelope Cuttings | 3.25 | " | — |
| Triple Sorted, No. 1 Brown Soft Kraft | 2.50 | " | — |
| New 100% Kraft Corrugated Cuttings | 2.25 | " | — |
| No. 1 Assorted Old Kraft | 1.75 | " | — |
| New Jute Corrugated Cuttings | .90 | " | — |
| Old 100% Kraft Corrugated Containers | 1.75 | " | — |
| Old Corrugated Containers | 1.40 | " | — |
| Box Board Cuttings | .72½ | " | — |
| White Blank News | 1.65 | " | — |
| Overissue News | 1.10 | " | — |
| No. 1 News | 1.00 | " | — |
| No. 1 Mixed Paper | .95 | " | — |
| Old Corrugated Containers | .82½ | " | — |
| Mill Wrappers | 1.10 | " | — |

## Twines

All Prices Nominal

(F. o. b. Mill)

(Soft Fiber)

| | | | |
|---|---|---|---|
| Coarse Polished— | | | |
| India | .21 | @ | — |
| White Hemp | .21 | " | — |
| Fine Polished— | | | |
| Fine India | .26 | " | — |
| Unpolished— | | | |
| Box | .17¼ | " | — |
| Paper Makers | .17 | " | — |
| Tube Rope | .19 | " | — |
| Wall Paper | .20½ | " | — |
| Wrapping | .23 | " | — |
| Soft Fiber Rope | .19 | " | — |
| Cotton | .25 | " | — |

(Hard Fiber)

| | | | |
|---|---|---|---|
| Medium Java | .18 | " | — |
| Mex. Sisal | .16 | " | — |
| Manila | — | " | — |

# PHILADELPHIA

## Domestic Rags (New)

(Price to Mill)

| | |
|---|---|
| Shirt Cuttings— | |
| New White No. 1 | .07¼ |
| New White No. 2 | .05¾ |
| Light Silesias | .05¾ |
| Black Silesias, soft | .03¾ |
| New Unbleached | .07½ |
| Washable Prints | .04¼ |
| Washable No. 1 | .03 |
| Blue Overall | .05½ |
| Cottons—According to grades— | |
| Washable Shredding | .01¾ |
| Fancy Percales | .04¼ |
| New Black Soft | .03¼ |
| Khaki Cuttings— | |
| Unbleachable Cotton Cuttings | .03½ |
| Bleachable Cotton Cuttings | .04¼ |
| Men's Corduroy | .03½ |
| Ladies' Corduroy | .03 |
| Cottonades | .03¼ |

## Domestic Rags (Old)

| | | | |
|---|---|---|---|
| White No. 1—Repacked | 3.80 | @ | — |
| Miscellaneous No. 1 | 3.20 | " | — |
| Miscellaneous No. 2 | 2.65 | " | — |
| White No. 2—Repacked | 2.90 | " | — |
| Thirds and Blues— | | | |
| Miscellaneous | 1.80 | " | — |
| Repacked | 2.20 | " | — |
| Black Stockings— | | | |
| (Export) | Nominal | | |
| Roofing Stock— | | | |
| Foreign No. 1 | Nominal | | |
| Domestic No. 1 | 1.55 | " | — |
| Domestic No. 2 | 1.45 | " | — |
| Roofing Bagging | 1.35 | " | — |
| Old Manila Rope | 5.75 | " | — |

## Bagging

(F. o. b. Phila.)

| | | | |
|---|---|---|---|
| Gunny No. 1— | | | |
| Foreign | Nominal | | |
| Domestic | 3.00 | @ | 3.50 |
| No. 1 Clean Bright— | | | |
| Sisal Strings | .04 | " | — |
| No. 2 Clean Bright— | | | |
| Sisal Strings | .03 | " | — |
| Sisal Jute | .02½ | " | .02¾ |
| Scrap— | | | |
| No. 1 | 3.25 | " | 3.50 |
| No. 2 | 1.75 | " | 1.80 |
| Wool Tares, heavy | 4.00 | " | 4.25 |
| No. 1 New Light Burlap | 3.00 | " | 4.00 |
| New Burlap Cuttings | 3.75 | " | 4.00 |

## Old Papers

(F. o. b. Phila.)

OPA Maximum Prices, Baled

| | | | |
|---|---|---|---|
| No. 1 Hard White Envelope Cuts, one cut | 3.37½ | @ | — |
| No. 1 Hard White Shavings, unruled | 2.87½ | " | — |
| Soft White Shavings, one cut | 2.50 | " | — |
| White Blank News | 1.65 | " | — |
| Soft White Shavings, Misc. | 2.15 | " | — |
| No. 1 Hard White Shavings, ruled | 2.50 | " | — |
| No. 1 Fly Leaf Shavings | 1.67½ | " | — |
| No. 2 Fly Leaf Shavings | 1.12½ | " | — |
| No. 1 Groundwood Fly Leaf Shavings | 1.25 | " | — |
| No. 2 Groundwood Fly Leaf Shavings | .90 | " | — |
| Mixed Colored Shavings | .75 | " | — |
| New Manila Envelope Cuts, one cut | 2.87½ | " | — |
| Hard White Envelope Cuts, one cut | 3.37½ | " | — |
| Triple Sorted No. 1 Brown Soft Kraft | 2.50 | " | — |
| Mixed Kraft Env. & Bag Cuttings | 2.75 | " | — |
| Kraft Envelope Cuttings | 3.25 | " | — |
| No. 1 Heavy Books & Magazines | 1.92½ | " | — |
| New Manila Envelope Cuts, one cut | 2.87½ | " | — |
| New Manila Envelope Cuttings | 2.65 | " | — |
| White and Colored Tabulating Cards | 2.25 | " | — |
| Ground Wood Tabulating Cards | 1.35 | " | — |
| White Blank News | 1.65 | " | — |
| No. 1 Assorted Old Kraft | 1.75 | " | — |
| No. 1 Mixed Paper | .95 | " | — |
| Overissue News | 1.10 | " | — |
| Box Board Cuttings | .72½ | " | — |
| New Corrugated Cuttings, Kraft | 2.25 | " | — |
| Old 100% Kraft Corrugated Containers | 1.75 | " | — |
| Old Corrugated Containers | 1.40 | " | — |
| Jute Corrugated Cuttings | 1.07½ | " | — |

## Bagging

(F. o. b. Boston)

| | | | |
|---|---|---|---|
| Gunny Bagging— | | | |
| Foreign | (nominal) | | |
| Domestic | 2.75 | @ | 2.90 |
| Sisal Rope No. 1 | *4.75 | " | — |
| Sisal Rope No. 2 | * — | " | 4.00 |
| Mixed Rope | 1.60 | " | — |
| Transmission Rope— | | | |
| Foreign | (nominal) | | |
| Domestic | 2.75 | " | 3.00 |
| Manila Rope— | | | |
| Foreign | (nominal) | | |
| Domestic | 5.75 | " | — |
| Soft Jute Rope | 4.50 | " | 5.00 |
| Jute Carpet Threads | 3.00 | " | 3.50 |
| Bleachery Burlap | 8.50 | " | 9.00 |
| Scrap Burlap— | | | |
| Foreign | (nominal) | | |
| Domestic | 3.00 | " | 3.25 |
| South America | — | " | 3.25 |

# BOSTON

## Old Papers

(F. o. b. Boston)

OPA Maximum Prices, Baled

| | | | |
|---|---|---|---|
| No. 1 Hard White Shavings, unruled | 2.87½ | @ | — |
| No. 1 Hard White Shavings, ruled | 2.50 | " | — |
| Soft White Shavings, Misc. | 2.15 | " | — |
| No. 1 Fly Leaf Shavings | 1.67½ | " | — |
| No. 2 Fly Leaf Shavings | 1.12½ | " | — |
| No. 1 Groundwood Fly Leaf Shavings | 1.25 | " | — |
| No. 2 Groundwood Fly Leaf Shavings | .90 | " | — |
| Mixed Colored Shavings | .75 | " | — |
| New Manila Envelope Cuts, one cut | 2.87½ | " | — |
| Hard White Envelope Cuts, one cut | 3.37½ | " | — |
| Triple Sorted No. 1 Brown Soft Kraft | 2.50 | " | — |
| Mixed Kraft Env. & Bag Cuttings | 2.75 | " | — |
| Kraft Envelope Cuttings | 3.25 | " | — |
| No. 1 Heavy Books & Magazines | 1.92½ | " | — |
| New Manila Envelope Cuts, one cut | 2.87½ | " | — |
| New Manila Envelope Cuttings | 2.65 | " | — |
| White and Colored Tabulating Cards | 2.25 | " | — |
| Ground Wood Tabulating Cards | 1.35 | " | — |
| White Blank News | 1.65 | " | — |
| No. 1 Assorted Old Kraft | 1.75 | " | — |
| No. 1 Mixed Paper | .95 | " | — |
| Overissue News | 1.10 | " | — |
| Box Board Cuttings | .72½ | " | — |
| New Corrugated Cuttings, Kraft | 2.25 | " | — |
| Old 100% Kraft Corrugated Containers | 1.75 | " | — |
| Old Corrugated Containers | 1.40 | " | — |
| Jute Corrugated Cuttings | 1.07½ | " | — |

## Bagging

(F. o. b. Boston)

| | | | |
|---|---|---|---|
| Gunny Bagging— | | | |
| Foreign | (nominal) | | |
| Domestic | 2.75 | @ | 2.90 |
| Sisal Rope No. 1 | *4.75 | " | — |
| Sisal Rope No. 2 | * — | " | 4.00 |
| Mixed Rope | 1.60 | " | — |
| Transmission Rope— | | | |
| Foreign | (nominal) | | |
| Domestic | 2.75 | " | 3.00 |
| Manila Rope— | | | |
| Foreign | (nominal) | | |
| Domestic | 5.75 | " | — |
| Soft Jute Rope | 4.50 | " | 5.00 |
| Jute Carpet Threads | 3.00 | " | 3.50 |
| Bleachery Burlap | 8.50 | " | 9.00 |
| Scrap Burlap— | | | |
| Foreign | (nominal) | | |
| Domestic | 3.00 | " | 3.25 |
| South America | — | " | 3.25 |
| Wool Tares— | | | |
| Foreign | (nominal) | | |
| Domestic | 4.25 | " | — |
| Aust. Wool Pouches | — | " | 3.65 |
| New Zealand Wool Pouches | — | " | 3.50 |
| New Burlap Cuttings | 4.75 | " | 5.00 |
| Heavy Baling Bagging | 4.00 | " | 4.25 |
| Paper Mill Bagging | 2.50 | " | 3.00 |
| No. 2 Roofing Bagging | 1.35 | " | — |

* OPA Maximum Prices.

## Domestic Rags (New)

(F. o. b. Boston)

| | | | |
|---|---|---|---|
| Shirt Cuttings— | | | |
| New Light Prints | .04½ | @ | .04¾ |
| Fancy Percales | .04¾ | " | .05 |
| New White No. 1 | .06¾ | " | .07 |
| New Light Flannelettes | .05½ | " | .06 |
| Canton Flannels, Bleached | .06 | " | .06¼ |
| Underwear Cutters, Bleached | .06¼ | " | .06¾ |
| Underwear Cutters, Unbleached | .05¾ | " | .06 |
| Silesias No. 1 | .06 | " | .06¾ |
| New Black Silesias | .03 | " | .03¾ |
| Red Cotton Cuttings | .03½ | " | .04 |
| Soft Unbleached | .06½ | " | .06¾ |
| Blue Cheviots | .05½ | " | .06 |
| Fancy | .02¾ | " | — |
| Washable | .02¾ | " | — |
| Khaki Cuttings | .02¾ | " | .03 |
| O. D. Khaki | .03½ | " | .03¾ |
| Corduroy | .03½ | " | .03¾ |
| New Canvas | .06¾ | " | .06½ |
| B. V. D. Cuttings | .06¼ | " | .06½ |

## Domestic Rags (Old)

(F. o. b. Boston)

| | | | |
|---|---|---|---|
| White No. 1— | | | |
| Repacked | 3.80 | @ | — |
| Miscellaneous | 3.20 | " | — |
| White No. 2— | | | |
| Miscellaneous | 2.65 | " | — |
| Twos and Blues, Repacked | 2.20 | " | — |
| Old Blue Overalls | 2.25 | " | 2.50 |
| Thirds and Blues, Repacked | 2.20 | " | — |
| Miscellaneous | 1.80 | " | — |
| Black Stockings | 3.50 | " | 4.00 |
| Roofing Stock— | | | |
| No. 1 | 1.55 | " | — |
| No. 2 | 1.45 | " | — |
| No. 3 | 1.35 | " | — |
| No. 4 | 1.35 | " | — |
| No. 5, Quality A | 1.85 | " | — |
| Quality B | 1.80 | " | — |
| Quality C | .95 | " | — |
| Old Manila Rope | 5.75 | " | — |

* OPA Maximum Prices.

## Foreign Rags

(F. o. b. Boston)

| | |
|---|---|
| Canvas | (nominal) |
| Dark Cottons | (nominal) |
| Dutch Blues | (nominal) |
| New Checks and Blues | (nominal) |
| Old Fustians | (nominal) |
| Old Linsey Garments | (nominal) |
| New Silesias | (nominal) |

# CHICAGO

## Waste Paper

(F. o. b. Chicago)

OPA Maximum Prices, Baled

| | | | |
|---|---|---|---|
| Shavings— | | | |
| No. 1 Hard White Envelope Cuts, one cut | 3.37½ | @ | — |
| No. 1 Hard White Shavings, unruled | 2.87½ | " | — |
| No. 1 Soft White Shavings | 2.50 | " | — |
| No. 1 White Ledger | 2.30 | " | — |
| No. 1 Heavy Books & Magazines | 1.92½ | " | — |
| White Blank News | 1.65 | " | — |
| Mixed Kraft Env. & Bag Cuttings | 2.75 | " | — |
| No. 1 Assorted Old Kraft | 1.75 | " | — |
| Overissue News | 1.10 | " | — |
| No. 1 News | 1.00 | " | — |
| No. 1 Mixed Paper | .95 | " | — |
| No. 1 Roofing Rags | 1.55 | " | — |
| No. 1 Roofing Bags | 1.45 | " | — |